

# THE SEAMANS SECRETS.

Divided into two parts, wherein is taught  
the three kindes of Sayling, *Horizontall, Pa-  
radoxall, and Sayling upon a great Circle.*

Also an Horizontall Tyde-Table for the easie  
finding of the ebbing and flowing of the Tydes, with  
*a Regiment newly calculated for the finding of the  
Declination of the Sunne, and many other most  
necessary Rules and Instruments, not heere-  
tofore set forth by any.*

Newly corrected and amended, and the  
fourth time Imprinted.



L O N D O N,

Printed by Iohn Dawson, and are to be sold  
by Iohn Bellamie, at the three golden Lyons  
in Cornewall, neere the Royall Exchange.

1 6 2 6.

THE  
SEAMANS  
SECRETS

Divided into two parts, wherein is taught  
the three kinds of sailing, To wit, the  
natural, and sailing upon a great circle.

Also an Horizontal Tyde-Table for the ease  
finding of the ebbing and flowing of the Tydes, with  
a Table newly calculated for the finding of the  
Declination of the Sun, and many other most  
useful Rules and Astronomical Tables  
before he hath by any.


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Printed by Iohn Dawson and are to be sold  
by the Stationers, at the three Golden Globes  
in Cornhill, near the Royal Exchange.  
1 6 2 6.



  
**To the right honorable Lord Charles**  
*Howard, Baron of Effingham, Knight of the no-*  
*ble order of the Garter, Lieutenant of her Maiesties*  
*Counties of Sussex and Surrey. Constable of her*  
*Maiesties Honour and Castle of Winsor, Lord high*  
*Admirall of England, Ireland, and Wales, and*  
*of the Dominions and Isles of the same, of the*  
*towne of Calles and Marches thereof, Nor-*  
*mandy, Gascony, and Greynes, Captaine ge-*  
*nerall of her Maiesties Seas and Navie*  
*royall, and one of her Maiesties most*  
*honourable privie Counsell, Iohn Da-*  
*vis wisheib increase of honour*  
*and perfect felicitie.*



Ight Honourable and my speci-  
 all good Lord, as by the instinct  
 of nature, all men are desirous  
 of knowledge, and take plea-  
 sure in the varieties of vnder-  
 standing, so it is likewise in-  
 grafted by the same benefit of  
 nature, in the hearts of true no-  
 bilitie, not onely to excell the  
 vulgar sort, but also to cheerish,  
 support, and countenance all such as shall in due course pro-  
 secute their vocation: and as such practises either speculatiue  
 or mecanicall, shall receiue favourable place in the honoura-  
 ble opinion of nobilitie, by so much the more shall the prac-  
 tiser be esteemed: which is the cause that at this time imbol-  
 deneth me to present vnto your most honourable favour  
 this small Treatise of Navigation, being a brieve collection  
 of such practises as in my severall Voyages I haue from ex-  
 perience collected. Among which in three severall attempts  
 for the discovery of the Northwest passage, thereby to finde

## The Epistle Dedicatorie.

a short & navigable course vnto the rich and famous countries of *Cathayo, China, Pegu*, the Isles of *Molucan* and *Philippina*, that therby to the great and inestimable benefit of our Countrey, there might be a rich and plentiful trade procured betweene vs and the said Nations, in short time to be performed, and with great safetie in regard of the course: which action and discovery (by meanes of that honourable Counseller Sir *Francis Walsingham* Knight, principall Secretary to her *Maiestie*) was with good resolution accepted by the Marchants of London, but in the decay of his honourable life, the attempt was likewise quailed: but howsoever mens mindes alter, yet vndoubtedly, there is passage navigable, and easie to be performed by that course (whensoever it shall please God to reveale the same) by invincible reasons, and sufficient experience to be proved: and although before I entred into that discovery, I was sufficiently perswaded of the certaintie thereof, by historicall relation, substantially confirmed, whereof to the Adventurers I made sufficient prooffe, but especially to my worshipfull good friend Maister *William Sanderson*, the onely Marchant that to his great charges, with most cōstant travaile, did labour for the finishing thereof: yet I thanke God that of late it hath beene my very good chance, to receiue better assurance then ever before of the certaintie of that passage, and such was my vehement desire for the performance thereof, that thereby I was onely induced to goe with M. *Candish* in his second attempt for the South Seas, vpon his constant promise vnto me, that when we came to the *California*, I should there haue his Pin-nice with my owne Bark (which for that purpose went with me to my great charges) to search that Northwest discovery vpon those backe parts of *America*, but God hath otherwise disposed our purposes in his divine Iudgements, for Maister *Candish* being halfe way through the straights of *Magilane*, and impatient of the tempestuous furiousnesse of that place, having all his Shippes and company with him, returned for *Brasil*, by the authoritie of his command, when with a leading wind we might haue passed the same, and returning  
more



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more then 80. leagues toward *Brasill*, my selfe being in his Ship named the *Desire*, without Boate, Oares, Sayles, Cables, cordage, victuals or health of my company sufficient for that attempt, was separated in a freit of weather, and forced to seeke the next shore for my reliefe, and recovering a harborow by vs named *Port Desire*, being in the latitude of 48. deg. did there repaire my most miserable wants, and there staying foure moneths in most lamentable distresse, did againe conclude with my company, to giue another attempt to passe the straights, as my best meane to gaine reliefe. And three times I was in the South Seas, but still by furious weather forced backe againe : yet notwithstanding all this my labour to performe the Voyage to his profite, and to saue my selfe ( for I did adventure and my good friends for my sake 1100. pounds in the action ) M. *Candish* was content to account me to be the authour of his overthrow, and to write with his dying hand that I ranne from him, when that his owne Ship was returned many moneths before me.

I am bold to make this relation vnto your Lordship, onely to satisfie your Honor of my conversation, for were I faultie of so foule a crime, I were worthy of ten thousand torments, in presuming to present this Treatise to your honorable Lordship, and now referring my cause to your Lordships consideration, I will againe returne to my purpose.

In those Northwest voyages, where Navigation must be executed in most exquisite sort, in those attempts I was enforced to search all possible meanes required in sayling, by which occasion I haue gathered together this brieft Treatise, which with my selfe I doe dedicate to your honourable protection, being desirous if it lay in my power, to doe farre greater matters in your Lordships service, hoping of your honourable pardon, because it is onely done to shew my dutifull affection, & not for any singularitie that the worke containeth. For I thinke there be many hundreds in England that can in a farre greater measure and more excellent methode expresse the noble art of Navigation, and I am fully perswaded that our Countrey is not inferiour to any for men of rare knowledge, singular explication, and exquisite

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execution of the Arts Mathematicke, for what strangers may be compared with M. *Thomas Digges* Esquire, our Countryman the great Maister of Archmairie, and for Theoricall speculations and most cunning calculation, M. *Dee* and M. *Thomas Heriotts* are hardly to be matched: and for the mechanicall practises drawne from the Arts of Mathematicke, our Countrey doth yeeld men of principall excellencie, as M. *Emery Mullenoux* for the exquisite making of Globes bodies, and M. *Nicholas Hellyar* for the singularitie of portraiture, haue the praise of Europe, M. *Baker* for his skill and surpassing grounded knowledge for the building of Ships advantageable to all purposes, hath not in any Nation his equall.

And now that I may returne to the painefull Seaman, it is not vnknowne to all Nations of the earth, that the English goeth before all others in the practises of sayling, as appeareth by the excellent discovery of Sir *Francis Drake* in his passage through the straights of *Magilane*, which being then so rashly knowne, he could not haue passed, vnlesse he had bin a man of great practise and rare resolution: so much I may boldly say, because I haue seene & tasted the frowardnesse of the place, with the great vnlikelihood of any passage to be that way.

I might here repeate the most valiant & excellent attempts of Sir *Hugh Willoughbie*, Sir *John Hawkins*, Sir *Humphry Gilbert*, and your Lordships servant M. *George Raymond*, with diuers others that haue given most resolute attempts in the practises of Navigation, aswell for the discovery as other execution, whereby good prooffe is made, that not onely in the skill of Navigation, but also in the mechanicall execution of the practises of sayling, wee are not to be matched by any Nation of the earth.

And sith Navigation is the meane whereby Countreyes are discovered, and communitie drawne betweene Nation and Nation, the word of God published to the blessed recovery of the forraine ofcasts from whence it hath pleased his diuine Maiestie as yet to detaine the brightnesse of his glory: and that by Navigation common-weales through mutuall

all



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all trade are not onely sufficiently susteined, but mightily enriched, with how great esteeme ought the painefull Seaman to be embraced by whose hard adventures, such excellent benefits are atcheiued, for by his exceeding great hazards, the forme of the earth, the quantities of Countries, the diversitie of Nations, and the natures of Zones, Climats, Countries and people, are apparantly made knowne vnto vs. Besides, the great benefits mutually interchanged betweene Nations, of such fruits, commodities, and artificiall practises wherewith God hath blessed each particular country, coast, and nation, according to the nature and scituation of the place.

For what hath made the *Spanyard* to be so great a Monarch, the Commander of both *Indias*, to abound in wealth and all natures benefits, but onely the painefull industrie of his Subiects by Navigation, their former trade was only figs, oringes, and oyle, but now through Navigation is brought to be gold, silver, pearles, silkes, and spice, by long and painefull trade recovered. Which great benefits onely by her *Majesties* loving clemency & mercifull favour he doth possesse: for if her Highnes and her most honourable Lords would not regard the small distance betweene her dominions and those famous rich Kingdomes, the easinesse of the passage being once discovered (the Northwest I meane) with the full sufficiency of her Highnes Subiects to effect the same, there could then be no doubt, but her stately seat of *London* should be the storehouse of *Europe*, & a nurse to all Nations, in yeelding all Indian commodities in a farre better condition, and at a more easie rate then now brought vnto vs, exchanging commodities of our owne store, with a plentifull returne at the first hand, which now by many exchanges are brought vnto vs.

Then should the *Spanyard* againe returne to his olde trade, and our sacred Sovereigne be seated the Commander of the earth: which trade and most fortunate discovery, we aboue all nations ought most principally to regard, because of the singularitie and invincible force of our Shipping, which is not onely the commanding Fortresse of our Country, but

also

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also the dread of our adversary, and the glory of our nation: wherein we doe in no sort flatter our selues, for it was made apparant to all Nations of the earth, by the late most famous conquest that her *Maiessty* had against the huge supposed invincible fleet of the *Spanyard*, being by her *Navie* vnder the command of your Lordship, who there in person & in place of her *Maiesstie*, to your eternall glorious fame did disgrace their glory and confound their force, and manifest their weakenesse by their dastardly flight, through Gods providence and your Lordships itately resolution.

Then sith Navigation is a matter of so great moment, I suppose that every man is bound in duty to giue his best furtherance thereunto: among whom as the most vnmeete of all, yet wishing all good to the painefull traveller, I haue published this short Treatise, naming it the *Seamans Secrets*, because by certaine questions demaunded and answered, I haue not omitted any thing that appertaineth to the secret of Navigation, whereby if there may grow any increase of knowledge or ease in practise, it is the thing which I chiefly desire.

To manifest the necessary conclusions of Navigation in briebe and short tearmes, is my onely intent, and therefore I omit to declare the causes of tearmes and definition of artificiall wordes, as matter superfluous to my purpose, neither haue I layde downe the cunning conclusions apt for Schollers to practise vpon the shore, but onely those things that are needfully required in a sufficient Seaman: beseeching your honourable Lordship to pardon my boldnesse, and with your favourable countenance to regard my dutifull affection, I most humbly commit your good Lordship to the mercies of God, who long preserue your health, with continuall increase of honour.

From Sandrudge by Dartmouth  
the 10. of August. 1594.

Your Lordships in all duti-  
full service to command,

JOHN DAVIS.





THE  
FIRST BOOKE OF  
THE SEAMANS SECRETS.

What is Navigation?



Navigation is that excellent Art which demonstrateth by infallible conclusions, how a sufficient Ship may be conducted the shortest good way from place to place, by Course and Travers.

What are these infallible conclusions?

**N**avigation consisteth of three parts, which being well understood and practised, are conclusions infallible, whereby the skilfull Pilote is void of all doubt to effect the thing purposed. Of which, the first is the Horizontall Navigation, which manifesteth all the varieties of the Ships motion within the Horizontall plaine superficies, where every line drawne is supposed a parallel.

The second is a paradoxall or Cosmographicall Navigation, which demonstrateth the true motion of the Ship upon any course assigned in longitude, latitude, and distance, either particular or generall, and is the skilfull gathering together of many Horizontall Courses, into one infallible and true motion paradoxall.

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The third is great Circle Navigation, which teacheth how to go on a great Circle drakone betweene any two places assigned, (being the onely shortest way betweene place and place) the Shippe may be conducted, and is performed by the skilfull application of Horizontall and paradoxall Navigation.

What is a Corse?

**A** Corse is that paradoxall line which passeth betweene place and place, according to the true Horizontall position of the Magnet, upon which line the Ship prosecuting her motion, shall be conducted betweene the sayd places.

What is a Trauers?

**A** Trauers is the varietie or alteration of the Shippes motion, upon the shift of winde within any Horizontall plaine superficies, by the good collection of which Trauerses, the Ships uniforme motion or Corse is given.

What Instruments are necessary for the execution of this excellent skill.

**T**he Instruments necessary for a skilfull Seaman, are a Sea Compasse, a crosse staffe, a Quadrant, an Astrolabie, a Chart, an instrument magneticall for the finding of the variation of the Compasse, an Horizontall plaine Sphere, a Globe, and a paradoxall Compasse. By which instruments, all conclusions and infallible demonstrations, Hydriographicall, Geographicall, and Cosmographicall, are without controlement of error to be performed: but the Sea Compasse, Chart, and Crosse staffe, are instruments sufficient for the Seamans vse: the Astrolabie and Quadrant being instruments very vncertaine for Sea observations.

What

JOHN DAVIS.



# The Seamans Secrets.

What is the Sea Compasse?

**T**he Sea Compasse, is a principall instrument in Navigation, representing & distinguishing the Horizon, so that the Compasse may conveniently be named an Artificiall Horizon, because by it are manifested all the limits and distinctions of the Horizon, required to the perfect vse of Navigation, which distinctions are the 32. points of the Compasse, whereby the Horizon is devided into 32. equall parts, and every of those points hath his proper name, as in the figure following appeareth. Also every point of the Compasse both containe degrees, minutes, seconds, & thirds, &c. Which degrees are called degrees of Azimuth, whereof there are in every point  $1\frac{1}{2}$ . so that the whole Compasse or Horizon containeth 360. degrees of Azimuth, for if you multiply  $1\frac{1}{2}$ . degrees, the degrees that each point containeth, by 32. the points of the Compasse it yeeldeth 360. the degrees of the Compasse. And of minutes each point containeth 45. being  $\frac{1}{4}$  of an houre, so that the whole Compasse is hereby devided into 24. houres, by which account there are in an houre 15. degrees, so that every degree containeth 4. minutes of time, for an houre consisting of 60. minutes hath for his fiftieth part 4. minutes of time, and in every minute there is firtie seconds, and every second containeth firtie thirds, either in degrees applyed to time, or degrees applyed to measure: so that the generall content of the Compasse is 32. points, 360. degrees, and 24. houres with their minutes, seconds, and thirds.

What is the vse of the 32 points of the Compasse.

**T**he vse of the 32 points of the Compasse, is to direct the skillfull Pilote by Horizontall traues, how he may conclude the course or paradoxall motion of his Ship, thereby with the greater expedition to recover the place desired, because they diuide the horizon in such limits as are most apt for Navigation, they doe also distinguish the windes by their proper names, for the winde receiveth his name by that part of the Horizon from whence it bloweth.

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What is the vse of 360. degrees of Azimuth?

**B**y the degrees of Azimuth is knowne the quantity of the rising and setting of the Sunne, Moone, and Starres, whereby is knowne the length of the dayes and nights in all climates, and at all times, they also shew a most precise Horizontall distinction of the motion of the Sunne, Moone, and Starres, whereby the certaintie of time is measured, and the variation of the Compasse, with the Poles height, is ingeniously knowne at all times and in all places by the helpe of the Globe.

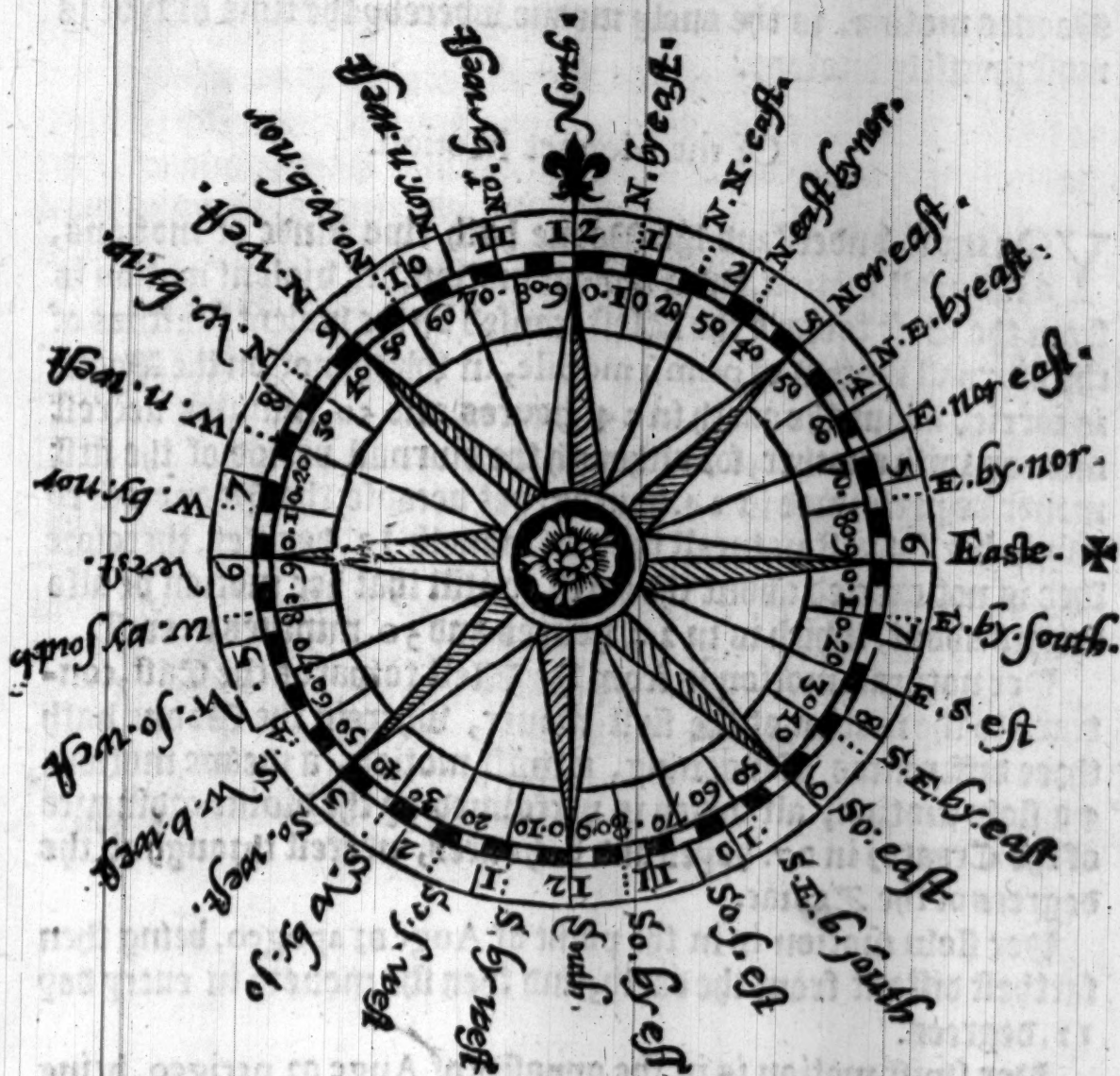
How is the houre of the day knowne by the Compasse?

**I**t hath bene an ancient custome among Mariners to deuide the Compasse into 24. equall parts or houres, by which they haue vsed to distinguish time, supposing an East Sunne to be 6. of the clocke, a Southeast Sunne 9. of the clocke, and a South Sunne 12. of the clocke, &c. as in the figure following shall plainly appeare. But this account is very absurd, for with vs in England (the Sunne hauing his greatest North declination,) it is somewhat past 7. of the clocke, at an East Sunne, and at a Southeast Sunne it is past 10. of the clocke: also when the Sunne is in the Equinoctiall, the Sunne is halfe the day East, and halfe the day West, to all those that be vnder the same, so that the Sunne then and to those people vseth but two points of the Compasse, to performe the motion of 12. houres: therefore the distinctions of time may not well be giuen by the Compasse, vnlesse the Sunne be vpon the Meridian, or that you be farre toward the North, in such places where the Sunnes Horizontall motion is very oblique, for there the houre may be giuen by the Compasse, without any great errour, but else where it cannot. Therefore those that trauaile must either vse the Globe, or an Equinoctiall Diall, by whom time may be most certainly measured, if there be good consideration of the variation of the Needle, by which the Equinoctiall Diall is directed, for this is a generall thing to be regarded, as well in the Compasse, as in any dials or other instrument, or conclusion whatsoeuer, wherein the vse of the Needle is required, that vnlesse there be good regard vnto the variation of the same, there can no good conclusion follow of any such practises.

What



# The Seamans Secrets.



What is the next necessary thing to be learned?

**H**aving perfectly learned the compasse, the next necessary thing for a Seaman to know, is the alteration or shifting of tydes, that thereby he may with the greater safette bring his Ship into any barred port, haven, creeke, or other place, where tydes are to be regarded. And this difference of tydes in the alteration of flowing and reflowing, is by long experience found to be governed by the Moones motion, for in such proportion of time as the Moone doth separate her selfe from the Sunne, by the swiftnesse of her naturall motion: in the like proportion of time doth one tyde differ from

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from another, therefore to vnderstand this difference of the Moones motion, is the onely meane whereby the time of tyde is most precisely knowne.

### Of the Moones Motion.

**Y**ou must vnderstand the Moone hath two kinde of motions, a naturall motion, and a violent motion, her violent motion is from the East toward the West, caused by the violent swiftnesse of the diurnall motion of primū mobile, in which motion the Moone is carried about the earth in 24. houres and 50. minutes neereſt one day with another, for although the diurnall period of the first mouer be performed in 24. houres, yet because the Moone euery day in her slowest naturall motion moueth 12. degrees, therefore ſhee is not carried about the earth, untill that her motion be alſo carried about, which is in 24. houres and 50. minutes neereſt.

Her naturall motion is from the West towards the East, contrary to the motion of the first mouer, wherein the Moone hath three differences of moouing, a swift motion, a meane motion, & a ſlow motion, all which is performed by the diuine ordinance of the Creator in 27. dayes and 8. houres, neereſt through all the degrees of the Zodiac.

Her ſlow motion is in the point of Auge or apogeo, being then fartheſt diſtant from the earth, and then ſhe moueth in euery day 12. degrees.

Her ſwift motion is in the oppoſite of Auge or perigeo, being neereſt vnto the earth, at which time ſhe moueth 14. degrees, with ſome ſmall difference of minutes in euery 24. houres.

Betweene thoſe two points is her meane motion, and then ſhe moueth 13. degrees neereſt: all which differences are cauſed by the eccentricitie of her Orbe wherein ſhe mooueth, and are onely performed in the Zodiac, but the Sea men for their better eaſe in the knowledge of the tydes, haue applied this the Moones motion to the points, degrees, and minutes of the Compaſſe, whereby they haue framed it to be an Horizontall motion, which ſith by long practiſe is found to be a rule of ſuch certaintie, as that the error thereof bringeth no danger to the expert Seaman, therefore it is not amiſſe to followe their practiſed precepts therein.



## The Seamans Secrets.

In euery 29. dayes 12. houres 44. minuts with another thzough the yeare, the Sunne and Moone are in coniunction, and therefore that is the quantitie of time betweene change and change, for although the Moone in 27. dayes and 8. houres, performing her naturall motion, doth returne to the same minute of the Zodiac from whence she departed, yet being so returned, shee doth not finde the Sunne in that part of the Ecliptick where shee left him, for the Sunne in his naturall motion moving euery day one degree towards the East, is moued so far from the place where the Moone left him, as that the Moone cannot ouertake the Sunne to come in coniunction with him, vntill she haue performed the motion of 2. dayes, 4. houres, and 44. minutes neereft, more then her naturall revolution, and that is the cause wherefore there are 29. dayes, 12. houres, 44. minutes betweene change and change one with another thzough the whole yeare: but the Seaman accompteth the Moones motion, to be vniforme in all places of the Zodiac alike, limittting her generall separation from the Sunne to be such as is her slowest naturall motion, which is 12. degrees, 02 48 minutes of time, in euery 24. houres.

By which accompt there are 30. dayes reckoned betweene change and change, being 11. houres, 16. minuts, more then in truth there is: but because this difference bycedeth but small error in their accompt of tydes, therefore to alter practised Rules where there is no vrgent cause, were a matter frivolous, which considered, I thinke it not amisse that we pzoceede therein by the same methode that commonly is exercised.

Allowing the Moone in euery 24. houres to depart from the Sunne 12. degrees, 02 48. minutes of time, and in this separation the Moone moueth from the Sunne Eastward, vntill shee be at the full, for betweene the change & the full, it is called the Moones separation from the Sunne: for after the full shee doth apply towards the Sunne, so that betweene the full and the change, it is called the Moones application to the Sunne, in which time of application she is to the Westward of the Sunne, as in her separation she is to the Eastward, or I may say in the Seamans phrase, all the time of her application she is before the Sunne, and in the time of her separation she is abaft the Sunne.

Then if the Moone doe make 48. minuts of time in 24. houres

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it followeth that she doth moue 24. minutes in 12. houres, and in 6. houres she moueth 12. minutes, therefore enery houre she moueth 2. minutes, and such as is the difference of her motion, such is the alteration of tydes, and therefore euery tyde differeth from the other 12. minutes, because there is 6. houres betweene tyde and tyde: and in euery houre the course of flowing or refloeing altereth 2. minutes, whereby it appeareth that in 24. houres the foure tydes of flowing and refloeing doe differ 48. minutes of time.

And sith the whole knowledge of this difference or alteration of tydes, as also the quantitie of the Moones seperation and application to and from the Sunne, dependeth vpon the knowledge of the Moones age, it is therefore necessary, that next you learne how the Sunne may be knowne.

For the performance whereof there are two numbers especially required, named the Prime and the Epact, for by the Prime the Epact is found, and by helpe of the Epact the Moones age is knowne.

Of the prime or Golden number.

**T**he prime is the space of 19. yeares, in which time the Moone performeth all the varieties of her motion with the Sunne, and at the end of 19. yeares beginneth the same revolution againe, therefore the prime neuer exceedeth the number of 19. and this prime doth alwayes begin in January, and thus the prime is found: vnto the yeare of the Lord wherein you desire to know the prime, adde 1. then diuide that number by 19. and the remaining number which commeth not into the quotient is the prime. Example in the yeere of our Lord 1590. I desire to know the prime, therefore I adde 1. vnto that yeare, and then it is 1591. which I diuide by 19. and it yeeldeth in the quotient 83. and there remaineth 14. vpon the diuision, which commeth not into the quotient, which 14. is the prime in the yeare of our Lord. 1590.

$$\begin{array}{r}
 1590 \\
 1 \\
 \hline
 1591
 \end{array}$$

$$\begin{array}{r}
 1 \\
 4 \\
 774 \\
 \times 83 \\
 \hline
 22212 \\
 5388 \\
 \hline
 123732
 \end{array}$$



## The Seamans Secrets.

**T**he Epact is a number proceeding from the ouerplus of the solar and lunar yeare, which number neuer exceedeth 30. because the Moones age neuer exceedeth 30. for the finding whereof this number onely serueth: and thus the Epact is knowne, which Epact doth allwayes begin in March, multiplie the prime by 11 (being the nearest difference betweene the solar and lunar yeare) deuide the product by 30. and the remainder is the Epact. Example in the yeare of our Lord 1590. I would know the Epact, first I seeke the prime of that yeare, and find it to be 14. I therefore multiplie 14. by 11. and that yeeldeth 154. which being deuided by 30. it giueth the quotient 5. and there remaineth 4. vpon the diuision, which 4. is the Epact in the yeare 1590. which beginning in March, doth continue vntill the next March of the yeare 1591.

$$\begin{array}{r}
 14 \\
 11 \\
 \hline
 14 \\
 14 \\
 \hline
 154
 \end{array}$$

$$\begin{array}{r}
 1545 \\
 30 \\
 \hline
 514
 \end{array}$$

Of the solar and lunar yeare.

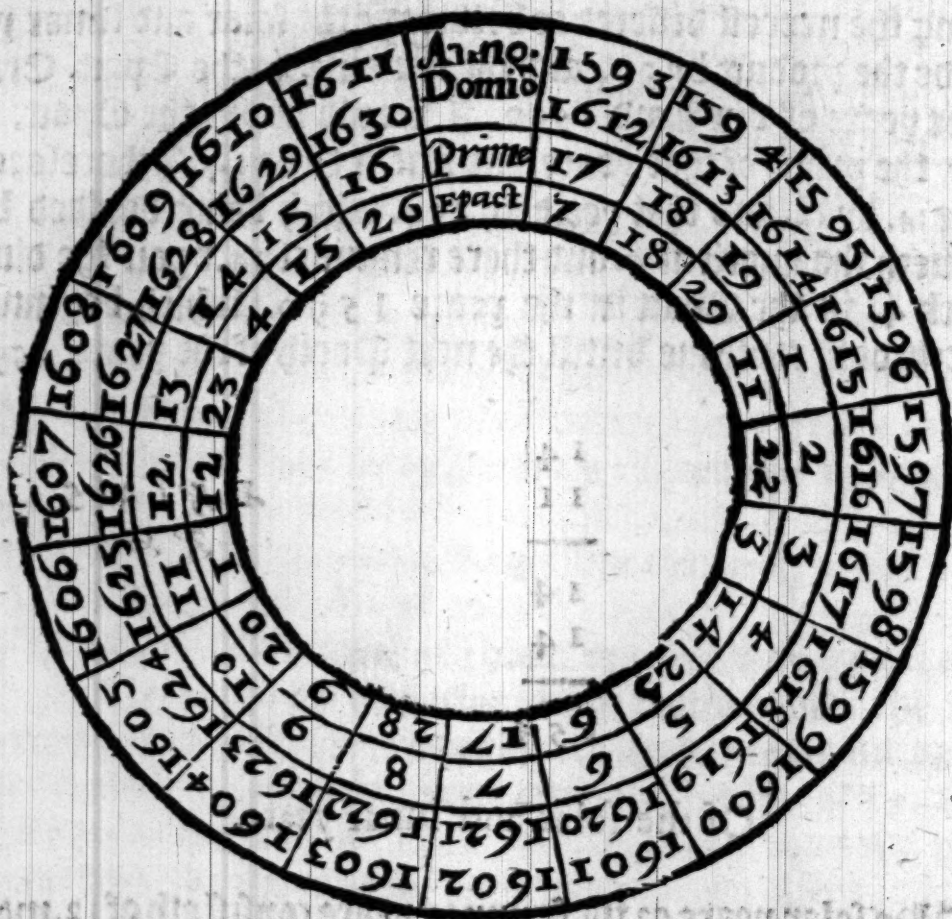
**T**he solar yeare or the Sunnes yeare consisteth of 12. moneths, being 365. dayes, and about 6. houres, the lunar yeare or the Moones yeare containeth 12. Moones, and euery Moone hath 29. dayes 12. houres, 44. minutes nearest, which amount vnto 354. dayes, 5. houres, 28. minutes, the content of the lunar yeare, which being substracted from 365. dayes, 6. houres, there resteth 11 daies and 23. minutes, the difference betweene the said yeares, from which difference the Epact commeth,

C

By

## The Seamans Secrets.

**B**y this Table the Prime and Epact may for ever be found, for when the yeeres be expired, you may begin againe and continue it for ever at your pleasure.



The first circle containeth the yeares of our Lord, the second the prime, and the third and inner circle sheweth the Epact: under every yeare you shall finde his prime and Epact, the prime beginneth in January, and the Epact in March.

How to finde out the Moones age.

the number  
moneths.

**F**irst consider the day of the moneth wherein you seeke the Moones age, then note how many moneths there are betwene the sayd moneth and March, including both moneths, unto those numbers adde the Epact of that yeare, that is, you must adde into one summe the day of the moneth, between March, & your moneth,



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reckoning both moneths and the Epact, all which numbers ioyned together, if they exceed not 30. is the Moones age, if they be more then 30. cast away 30. as often as you can, and the remainder is the Moones age, if it be less 30. it is then new Moone, if 7. it is the first quarter day, if 15. it is full Moone, if 22. it is then the last quarter day, and thus the Moones age is found for ever.

And now being able for all times either past, present, or to come, to give the Moones age, I thinke it good by a few questions convenient for the Seamans practise, to make you vnderstand the necessary vse thereof.

For the account of Tydes.

**W**hen you desire to know the time of full Sea in any place, at all such seasons as occasion shall require, you must first learne what Moone maketh a full Sea in the same place, that is, vpon what point of the Compasse the Moone is, when it is full Sea at the said place, you must also know what houre is appropriated to that point of the Compasse, as before is shewed: for vpon the change day it will alwayes be full Sea in that place, at the same instant of time, by which considerations you must thus proceede for the search of tydes.

Multiplye the Moones age by 4. deuide the product by 5. and to the quotient adde the houre, which maketh full Sea in that place vpon the change day, if it exceede 12. cast away 12. as oft as you may, and then the houre of full Sea remaineth, and for euery 1. that resteth vpon your diuision, allow 12. minutes to be added to the houre, for 2. 24. minutes, for 3. 36. and for 4. 48. minutes, for more then 4. will neuer remaine, & thus you may know your Tydes to a minute, example, the Moone being twelue dayes old, I desire to know the time of full Sea at London: first it is found by experience, that a South-west and North-east Moone makes full Sea at London, next I consider that 3. of the clocke is the houre appropriated to that point of the Compasse, which number I keepe in memorie, then I multiplye the Moones age, being 12. by 4. and that yeeldeth 48. which being deuided by 5. it giueth in the quotient 9. and 3. remaineth, I adde the quotient 9. to the houre 3. and it maketh 12. houres, and for the remaining number 3. I also adde

## The Seamans Secrets.

46. minutes, so that I finde when the Moone is 12. dayes olde, it is 12. of the clocke and 36. minuts past, at the instant of the full Sea at London: by this order you may at all places and times know the certaintie of your tydes at your pleasure.

But those that are not practised in Arithmetick, may account these tydes in this sort, knowing how many dayes old the Moone is, he must place the Moone vpon that point of the Compasse which maketh full Sea at the place desired, and then reckoning from that point with the Sunne according to the diurnall motion, must account so many points, and so many times 3. minutes as the Moone is dayes old, that is, for every day one point, and three minuts, and there finding the Sunne, he must consider what is the houre allowed to that point where he findeth the Sunne, for that is the houre of full Sea. As for Example, the Moone being 12. dayes old, I desire to know the houre of full Sea at London, now finding by former experience, that a Southwest Moone maketh full Sea at London, I therefore place the Moone vpon the point Southwest, then I account from the point Southwest 12. points, reckoning with the Sunne according to the diurnall motion, Southwest and by west for the first point, West Southwest for the second, West by South for the third, West for the fourth point, and so forth, untill I come to North, which is 12. points from the Southwest, and because the Moone moueth 3. minutes more then a point in every day, I therefore adde 3. times twelue, which make 36. minuts to the point North, at which place I finde the Sunne to be, and knowing that twelue of the clocke is appropriated to the point North. I may therefore boldly say that at twelue of the clocke 36. minutes past, it is full Sea at London, when the Moone is twelue dayes olde, which 36. minutes are added, because the Moone hath moued 36. minutes more then 12. points in those 12. dayes, which is one point and 3. minutes for every day, as before.

Here followeth a very necessary Instrument,  
for the knowledge of the Tydes, named  
*an Horizontall Tyde-Table.*



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Of this Instrument and his parts.

**T**his necessary instrument for the young practising Seamans vse, named an Horizontall Tyde-Table, whereby he may shift his Sunne and Moone (as they terme it) and know the time of his tydes with ease and very certainly, besides the answering of many pleasant and necessary questions used amongst Mariners) I have contrived into this methode, onely for the benefite of such yong practisers in Navigation.

The first part of this Instrument is a Sea Compasse, divided into 32. poyns or equall partes, the innermost circle of which Compasse is divided into 24. houres, and every of those into 4. quarters, each quarter being 15. minuts, and against every poyn of the Compasse those places are layde downe, in which places it is full Sea when the Moone commeth vpon the same poyn, so that whatsoeuer is required as touching time, or the points of the Compasse is there to be knowne.

The next moveable circle vpon this Compasse, is limited to the Sunne, vpon whose Index the Sunne is layd downe, which circle is divided into 30. equall parts or dayes, signifying the 30. dayes betweene change and change, according to the Seamans account, so that whatsoeuer is demanded as touching the age of the Moone, is vpon that circle to be knowne.

The vppermost moveable circle is applyed to the Moone, vpon whose Index the Moone is layd downe, which is to be placed either to the points and partes of the Compasse, or to the time of her age, as the question requireth, which considered, the vse of this Instrument is largely manifested, by these questions with their answers following.

How to know the houre of the night by the Moone, being vpon any poyn of the Compasse by this Instrument.

1. Q. The Moone 10. dayes olde, I demand what is a clocke, when she is East Northeast.

1. A. In this question the Moones age and the poyn of the Compasse is giuen, thereby to know the houre, I therefore place  
the

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the index of the moone vpon the point East North-east, there keeping the same not to be moued, then because the moone is 10. daies olde, I moue the Index of the Sunne vntill I bring the 10. day of the moones age vnto the Index of the moone, and there I looke by the Index of the Sunne, and finde vpon the Compasse that it is twelue of the clocke at noone & 30. minuts past, when the moone is vpon the poynt East North-east, being 10. dayes olde.

2. Q. The Moone being twelue dayes olde, I demand at what houre she will be vpon the poynt S. S. E.?

2. A. In this question the point of the Compasse and Moones age is giuen, as in the first, therefore I place the Index of the Moone vpon the point S. S. E. And there holding it without moving, I turne the Index of the Sunne, vntill the twelfth day of the moones age come to the Index of the Moone, and then the Index of the Sunne sheweth me vpon the Horizon the houre 8. therefore I say that at 8. of the clocke at night, the Moone was then vpon the poynt South Southeast.

And thus you may at all times know the houre of the night by the Moone, vpon any poynt of the Compasse, so that the Moones age be also had.

How by this Instruction, you may know at all times vpon what point of the Compasse the Moone is.

1. Q. When the Moone is 10. dayes olde, vpon what poynt of the Compasse shall she be, at 9. of the clocke in the morning.

1. A. In this question the houre of the day and the moones age is giuen, thereby to finde vpon what poynt of the Compasse shee is at the same time. I therefore place the Index of the Sunne vpon the Compasse, at the houre 9. of the clocke in the morning, being vpon the poynt Southeast, then I turne the Index of the Moone, vntill I bring it to the tenth day of her age, and then I see vpon the Compasse, that the moone is North and by East, and 15. min. to the Eastwards, of 9. of the clocke when she is 10. dayes olde.

2. Q. When the moone is 20. dayes olde, vpon what poynt of the Compasse will she be at 2. of the clocke in the afternoone?

2. A. I place the Index of the Sunne vpon the houre 2, noted in the Compasse, there holding the same without moving, then I turne



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turne the Index of the Moone, untill I bring it unto the 20. day of her age, and there I see upon the Compasse that shee is North-east and by North, and 15. minutes to the North-ward, at 2. of the clocke in the afternoone, when shee is 20. dayes old.

To finde the Moones age by this Instrument.

1. Q. When the Moone is North at 7. of the clocke in the afternoone, how old is shee?

1. A. In this question the point of the Compasse and the houre is given, for the finding of the Moones age: therefore I set the Index of the Sunne upon the houre 7. in the forenoone, there holding it without moving, then I bring the Index of the Moone to the point North, and then upon the circle containing the dayes of the Moones age, I see the Moone is 8. dayes and about 18. houres old, when shee is North at 7. of the clocke in the forenoone.

2. Q. When the Sunne is East and the Moone Southeast, how olde is the Moone?

2. A. In this question the points of the Compasse are onely given for the finding of the Moones age, therefore I set the Index of the Sunne upon the point East, there holding him steadie, then I put the Index of the Moone upon the point Southwest, and there I see that the Moone is 18. dayes and 18. houres olde, when the Sunne is East and shee Southwest.

After this order by the varietie of these few questions, you may frame unto your selfe many other pleasant and necessary questions, which are very easily answered by this Instrument: and entering into the reasons of their answers, you may very readily by a little practise, be able by memorie to answer all such questions with ease.

How to know the time of your tydes by this Instrument.

1. Q. When the Moone is 12. dayes olde, I desire to know the time of full Sea at London.

1. A. To answer this question, I first looke through all the points of the Compasse of my Instrument, untill I finde where London is written, for when the Moone cometh upon the point

of

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of the Compasse, it will then be full sea at London : therefore I place the Index of the Moone vpon the same poynt, which I finde to be South-west or North-east, there holding the Index not to be moued, then I turne the Index of the Sunne vntill I bring the twelfth day of the Moones age to the Index of the Moone, & then the Index of the Sunne sheweth me that at 12. of the clocke 36. minutes past, it is full sea at London, the Moone being 12. dayes olde.

2. Q. The Moone being 21. dayes olde, at what time is it full Sea at Dartmouth :

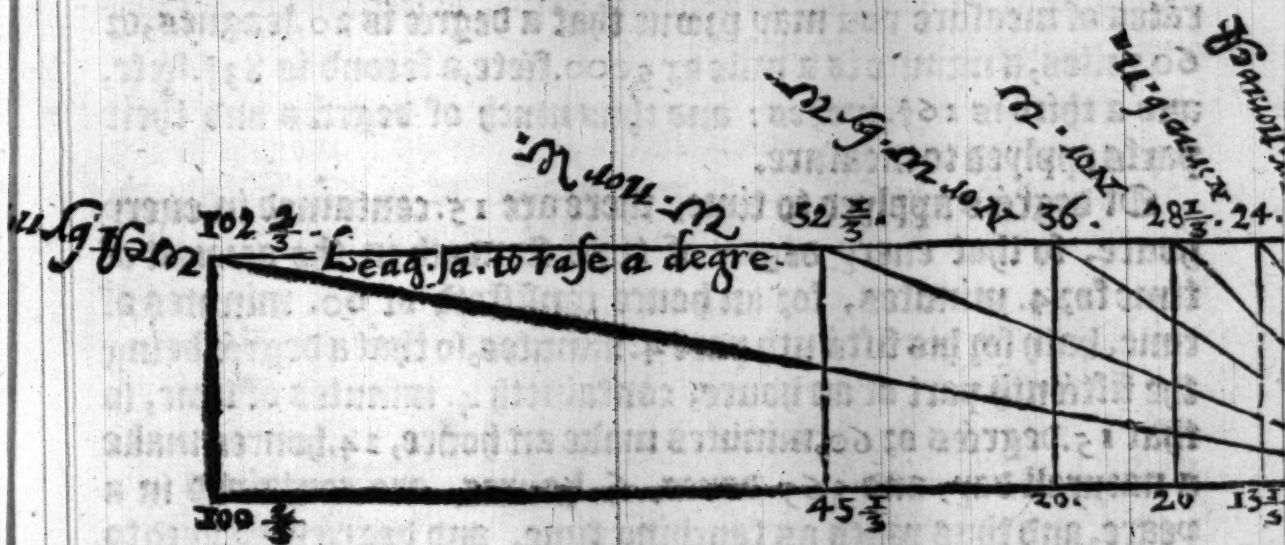
2. A. I finde vpon my Instrument, that Dartmouth is noted vpon the poyns East and West, whereby I know that when the Moone is East or West, it is alwayes full sea at Dartmouth : therefore I place the Index of the moone vpon the poynt East, and there holding it without mouing, I turne the Index of the Sunne, vntill I bring the 21. day of the Moones age vnto the Index of the Moone, and then the Index of the Sunne sheweth mee vpon the Compasse, that at 10. of the clocke and 48. minuts past, it is full sea at Dartmouth, when the Moone is 21. dayes olde, and not onely at Dartmouth, but my Instrument sheweth mee that at the same instant it is also full sea at Ermouth, Weymouth Plymouth, Mounts bay, at Lynne, and at Humber : and thus with great facilitie the time of flowings and refloings is most precisely knowne.

And now that there may be a finall end of the vses and effects of the Compasse, it is conuenient that I make knowne vnto you, how many leagues shall be sayled vpon euery particular poynt of the Compasse, for the raising or laying of the degrees of latitude, and in the distance sayling how farre you shall be separated from the Meridian, from whence the said courses are begun, for as euery point of the Compasse hath his certaine limited distance for the degrees of the Poles elevation, so doe they likewise lead from longitude to longitude, euery point according to his ratable limits, which distances of leagues are without alteration, keeping one and the same proportion in euery particular Horizon of any latitude, but the degrees of longitude answerable to such distances, doe differ in euery altitude, according to the nature of the parallel, as hereafter shall be moze plainly manifested. And now  
know.



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know, that in sayling North and South, you depart not from your Meridian, and in every 20. leagues sayling you raise a degré: North and by East raiseth a degré in sayling 20. leagues and one mile, and leadeth from the Meridian 4. leagues: North nor east raiseth a degré in sayling 21. leagues and two miles, leadeth from the Meridian 8. leagues and one mile: North by north raiseth a degré in sayling 24. leagues, and leadeth from the Meridian 13. leagues and a mile: North east raiseth a degré in sayling 28. leagues and a mile, and leadeth from the Meridian 20. leagues: North east by east raiseth a degré in sayling 36. leagues, and leadeth from the Meridian 30. leagues: East north east raiseth a degré in sayling 52. leagues and a mile, and leadeth from the Meridian 48. leagues and 2. miles: East and by north raiseth a degré in sayling 102. leagues and a mile, and leadeth from the Meridian 100. leagues and 2. miles: East and West do not raise or lay the Pole, but keepeth still in the same parallel: the like allowance is to be given to every quarter of the Compass, as is layd downe upon this Northeast quarter,



Leagues seperated from the Meridian in raising a degree.

**Q.** I perceiue that degrees are to great purpose in Nauigation.  
What is a degree?

**Ans.** It is most true, that degrees are of very great imploy-  
ment in Nauigation, and a degré is the 360. part of a cir-  
cle, how big or little soeuer the circle be, being applyed after the  
same

## The Seaman's Secrets.

seuerall sorts, for the better perfections of the practises Suber-nautick, so that there be degrees of longitude, degrees of latitude, degrees of Azimuth, degrees of altitude, degrees applyed to measure, and degrees applyed to time.

A degree of longitude is the 360. part of the Equinoctiall.

A degree of latitude is the 360. part of the Meridian.

A degree of Azimuth is the 360. part of the Compasse or Horizon.

A degree of altitude is the 90. part of the verticall circle, or the 90. part of the distance betwene the Zenith and the Horizon.

Every degree applyed to measure, both containe 60. minutes, and every minute 60. seconds, and every second 60. thirds, &c. and every degree of a great circle so applyed, containeth twentie leagues, which is 60. mile, so that every minute standeth for a time in the account of measures, & a mile is limited to be 1000. paces, every pace 5. fote, every fote 10. inches, and every inch 3. barley cornes dry and round, after our English account, which for the vse of Navigation is the only best of all other: so by these rates of measure you may perceiue that a degree is 20. leagues, or 60. miles, a minute is a mile or 5000. fete, a second is 83 $\frac{1}{3}$ . fete, and a third is 16 $\frac{2}{3}$ . inches: and thus much of degrees and their parts applyed to measure.

Of degrees applyed to time, there are 15. contained in every houre, so that every degree of time standeth in the account of time for 4. minutes, for an houre consisteth of 60. minutes of time, hath for his sixteenth part 4. minutes, so that a degree being the sixteenth part of an houre, containeth 4. minutes of time, so that 15. degrees or 60. minutes make an houre, 24. houres make a naturall day, and 365. dayes, 6. houres, are contained in a yeare, and thus much as touching time, and degrees applyed to time.

What is the vse of degrees?

**T**he vse of degrees is to measure distance betwene place and place, to find altitudes, latitudes, and longitudes, to describe Countries, to distinguish courses, to finde the variation of the Compasse, to measure time, to finde the places and motions of



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all celestiaall bodiees, as the Sunne, Moone Planets and Starres to conclude, by degrees haue bene performed all Mathematicall obseruations whatsoeuer, whose vse is infinite.

What is the Poles altitude, and how it may be knowne?

**A**ltitude is the distance, height, or mounting of one thing above another, so that the altitude of the pole, is the distance, height, or mounting of the Pole from the Horizon, & is defined to be that portion of the Meridian, which is contained betwene the Pole and the Horizon, which altitude or eleuation is to be found either by the Sunne, or by the fixed Starres, with the helpe of your Crosse Staffe, Quadzant, or Astrolabe, but the Crosse Staffe is the onely best instrument for the Seamans vse.

And in the obseruation of this altitude there are five things especially to be regarded: the first is, that you know your Meridionall distance betwene your Zenith and the Sun or Starres, which by your Crosse Staffe or Astrolabe is giuen: the second, that the declination be truely knowne at the time of your obseruation. And the other three are, that you consider whether your Zenith be betwene the Equinoctiall and the Sun or Starres, or whether the Equinoctiall be betwene your Zenith and them, or whether they be betwene your Zenith and the Equator, for there is a seuerall order of working vpon each of these three differences.

Latitude you must also know, that so much as the Pole is above the Horizon, so much is the Zenith from the Equinoctiall, and this distance betwene the Zenith and the Equator is called latitude or widenesse, and is that portion of the Meridian which is included betwene your Zenith and the Equator, for it is a generall rule for euer, that so much as the Pole is above the Horizon, so much the Zenith is from the Equinoctiall, so that in this sence, altitude and latitude is all one thing, the one hauing relation to that part of the Meridian, contained betwene the Pole and the Horizon, & the other to that part of the Meridian which is contained betwene the Zenith and the Equinoctiall.

You must further vnderstand, that betwene the Zenith and Horizon, it is a quarter of a great circle, containing 90. degrees,

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so that knowing how much the Sunne or any Starre is from the Horizon, if you take that distance from 90. the remainder is the distance betweene the said body and the Zenith. As for example, if the Sunne be 40. degrees 37. minuts from the Horizon, I subtract 40. degr. 37. min. from 90. and there remaineth 49. deg. 23. min. which is the distance betweene my Zenith & the Sunne &c. Those instruments that begin the account of their degrees at the Zenith, concluding 90. in the Horizon, are of most ease for the finding of the latitude by the Sunne or fixed Starres, because they giue the distance betweene the Zenith and the body observed, without further trouble, and that is the number which you must haue, and for which you doe search in your obseruation: all which things considered, you must in this sort proceed for the finding of the Poles height or altitude.

By the Sunne or fixed Starres being between the Zenith and the Equinoctiall, the latitude is thus found, in what part of the world soeuer you be.

**F**irst place the Crosse staffe to your eye, in such good sort as that there may growe no errour by the disorderly vsing thereof, for vnlesse the Center of your staffe and the Center of your sight doe ioyne together in your obseruation, it will be erroneous what you conclude thereby: your staffe so ordered, then moue the transuersary vpon your staffe to and fro as occasion requi-  
reth, vntill at one and the same instant you may see by the vpper edge of your transuersary halfe the body of the Sunne or Starres, & that the lower edge or end thereof doe likewise touch the Horizon, at that place where it seemeth that the Skie and Seas are ioyned, hauing especiall regard in this your obseruation, that you hold the transuersary as directly vpright as possible you may, and you must begin this obseruation somewhat before the Sunne or Starres be at South, and continue the same so long as you perceiue that they rise: for when they are at the highest, then are they vpon the Meridian, and then you haue the meridionall altitude which you seeke, at which time they will be due South from you, if your Compasse be good and without variation, and then doth the transuersary shew vpon the staffe the



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the degrees and minuts that the said body is from your Zenith, if the deg. of your Instrument be numbred from the Zenith toward the Horizon: or els it sheweth the distance betweene the said body & the Horizon, if the deg. of your Instrument be numbred from the Horizon, concluding 90. in the Zenith, as commonly Crosse Staues are marked, which is not the easiest way: but if your Staue be accounted from the Horizon, then subtract the degrees of your obseruation from 90. and the remainder sheweth the distance betweene your Zenith & the Sunne or Starres, which is þ number you must know: vnto that number so known by your Instrument, adde the declination of the body by which you doe obserue, whether it be the Sunne or any Starre, and that which commeth by the addition of those two numbers together is the Poles height, or the latitude of the place where you are: as for example. In the yeare of our Lord 1621. the third day of March, the Sunne being then betweene my Zenith and the Equinoctiall, I obserued the Sunnes Meridionall altitude from the Horizon to be 72. deg. and 20. min. but because I must know the distance of the Sunne from my Zenith, I therefore subtract 72. deg. 20. min. from 90. deg. and there remaineth 17. deg. 40. min. the distance of the Sunne from my Zenith, to that distance I adde the Suns declination for that day, which by my Regiment I finde to be 43. minuts 2. degrees of South declination, and it amounteth vnto 20. deg. 23. min. so much is the South pole aboue the Horizon, and so much is my Zenith South from the Equinoctiall, because the Sunne hauing South declination, and being betweene mee and the Equinoctiall, therefore of necessitie the Antartick pole must be aboue my Horizon.

89—60—the distance betweene	17—40—the suns di. frō the Ze.
the Zenith and the Horizon.	2—43—Suns declination.
72—20—the Sunnes altitude.	—
—————	20—23—Poles height.

When the Equinoctiall is betweene your Zenith and the Sunne or Starres, the altitude is thus found in all places.

**B**y your Instrument as befoze is taught, you must seeke the Meridionall distance of the Sun or Starres from your Zenith,

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nith, which being knowne, substract the declination of the Sun or Starres from the said distance, and the remaining number is the Poles height or latitude which you seeke: Example.

The 20. of October 1625. I finde by my Instrument that the Sunne is 60. deg. 45. min. from my Zenith at noone, being then vpon the Meridian, the Equatoz being then betweens my Zenith and the Sunne, I also find by my Regiment that at that time the Sunne had 13. deg. 57. min. of South declination, because the Equinoctiall is betweene me and the Sunne, therefore I substract the Sunnes declination from the obserued distance, and there resteth 46. deg. 48. min. the latitude desired, and because the Sunne hath South declination, and the Equinoctiall being betweens me and the Sunne, therefore I may conclude that the Pole Artick is 46. deg. 48. min. aboue my Horizon, or that my Zenith is so much toward the North from the Equatoz.

$$\begin{array}{r}
 \text{g} \quad \text{m} \\
 60-45 \text{---the Sunnes distance.} \\
 13-57 \text{---the declination.} \\
 \hline
 46-48 \text{---the latitude.}
 \end{array}$$

When your Zenith is betweene the Sunne or Starres and the Equinoctiall, the Latitude is thus found.

**B**y your Instrument as in the first example is shewed, you must obserue the Meridionall distance of the Sun or Stars from your Zenith, you must also by your Regiment or other Tables, search to know the declination of that body which you obserue, then substract the obserued distance from your Zenith out of the declination, and the remaining number is the latitude desired: Example. The Sunne hauing 20. deg. of North declination, and being vpon the Meridian is 5. deg. 9. min. from my Zenith, I therefore substract 5. deg. 9. min. from 20. deg. and there resteth 14. deg. 51. min. the latitude desired: and because the Sunne hath North declination, my Zenith being betweene the Sunne and the Equinoctiall, therefore I conclude, that the North Pole is 14. deg. 51. min. aboue my Horizon,

the



## The Seamans Secrets.

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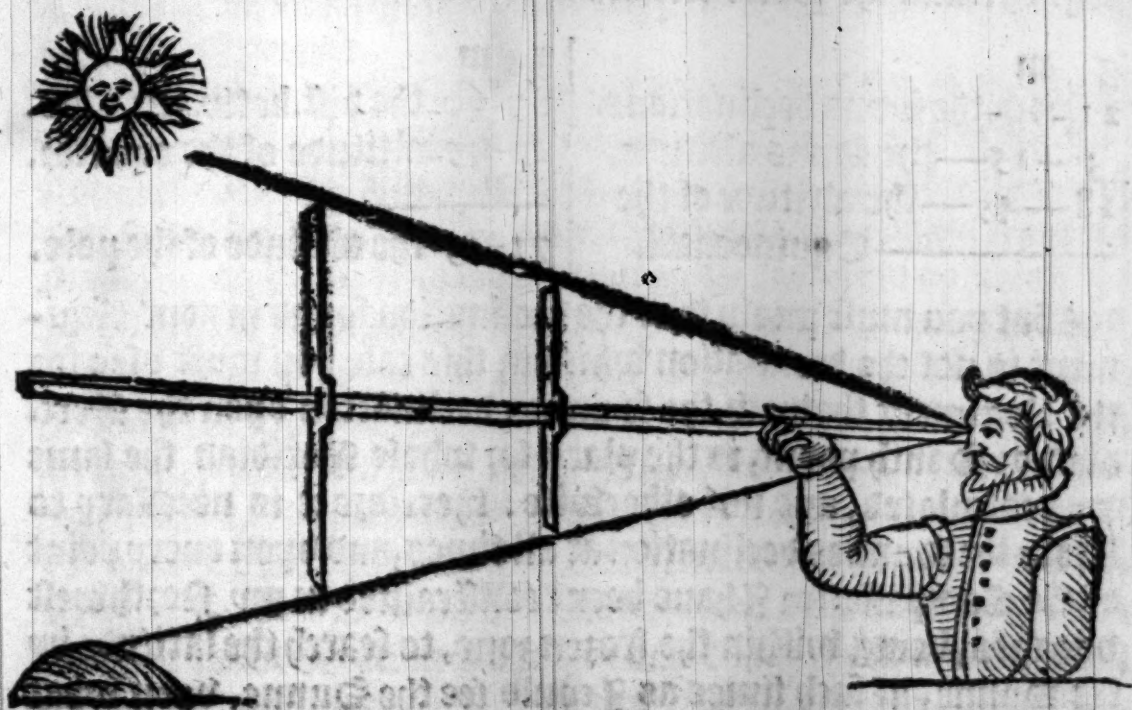
19—60—the declination.

5—9—the Sunnes distance from my Zenith.

14—51—the Poles height.

How shall I know the true order of placing the Crosse-staffe  
to mine eye, to auoyde errour in my obseruation?

**T**<sup>D</sup>o finde the true placing of the staffe at your eye, thereby to amend the parallar or false shadow of your sight, doe thus: take a staffe hauing two crosse, a long crosse which endeth in 30. degrees, and a short crosse which beginneth at 30. deg. where the long crosse endeth, put the long crosse vpon his 30. deg. and there make him fast, then put the short crosse likewise vpon his 30. deg. there fasten him without moving, then set the end of your staffe to your eye, moving it from place to place about your eye, vntill at one instant you may see the endes of both crosse, which when you finde, remember that place and the standing of your body, for so must your staffe be placed, & your body ordered in all your obseruations.



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Are these all the rules that appertaine to the finding  
of the Poles height?

**T**hose that trauell farre towards the North vnder whose  
Horizon the Sunne setteth not, shall sometime haue occasi-  
on to seeke the latitude by the Sunne when the Sun is North  
from them, the pole being then betwæne the Sunne and their  
Zenith. When such obseruations are made, you must by your  
Instrument seeke the Suns height from the Horizon, subtract  
that height from his declination, and the remaining number  
sheweth how farre the Equinoctiall is vnder the Horizon vpon  
the poynt North, so; so much is the opposite part of the Equa-  
tor aboue the Horizon vpon the poynt South, subtract that Me-  
ridian latitude of the Equinoctiall from 90. and the remaining  
number is the Poles height desired: Example.

The Sunne hauing 22. degrees of North declination, his al-  
titude from the Horizon is obserued to be 3. degrees, 15. minuts,  
therefore subtracting 3. deg. 15. min. from 22. degrees, there  
rest 18. deg. 45. min. which is the distance of the Equinoctiall  
from the Horizon, which being taken from 90. there resteth 71.  
deg. 15. min. the Poles eleuation desired.

g m	
21-60—the Suns declinations.	
3—15—the Suns altitude.	
18—45—the altitude of the	
<hr/> Equinoctiall.	

g m	
89-60—the dist. betw. zen. & Ho.	
18-45—altitude of the equator.	
<hr/>	
71-15—the altitude of the pole.	

But you must know that the declination found in your Regi-  
ment is not the declination which in this case you must vse: for  
the Regiment sheweth the Sunnes declination vpon the Meri-  
dian or South poynt, in the place for whose Meridian the same  
was calculated, and not otherwise: therefore it is necessary to  
know the Sunnes declination at all times, and vpon euery point  
of the Compasse: for I haue beene constrained in my North-west  
voyages, being within the frozen zone, to search the latitude by  
the Sunne, at such times as I could see the Sunne, vpon what  
poynt of the Compasse soeuer, by reason of the great fogges and



## The Seamans Secrets.

mistes that those Northern parts are subiect unto : and there is consideration also to be had vpon euery difference of longitude for the Sunnes declination, as I haue by my experience found at my being in the Straights of Magilane, where I haue found the Sunnes declination to differ from my Regiment calculated for London, by so much as the Sunne declineth in five houres, for so much is the difference betwene the Meridian of London, and the Meridian of Cape Froward, being in the midst of the said Straights.

How may this declination be found for all times, and vpon all poynts of the Compasse.

**F**irst consider whether the Sunne be comming towardes the Equinotiall, or going from him, that being knowne, consider the time wherein you seeke the declination, then looke for the Sunnes declination in your Regiment for that day, and also seeke his declination for the next day, subtract the lesser out of the greater, and the remainder is the whole declination which the Sunne declineth in 24. houres, or in his moving through all the poynts of the Compasse, from which number you may by the rule of proportion finde his declination vpon euery poynt of the Compasse for euery houre of the day, as by these examples may appeare : Example.

In the yere 1625. the 20. of March, I desire to know the Sunnes declination when he is vpon the North part of the Meridian of London, I seeke the Sunnes declination for that day, and finde it to be 3. deg. 59. min. the Sunne then going from the Equator, I also search his declination for the next day, being the 21. of March, and finde it to be 4. deg. 22. min. I then subtract 3. deg. 59. min. from 4. deg. 22. min. and there resteth 23. min. so much the Sun doth decline in 24. houres, or in going through all the poynts of the Compasse. Then I say by the rule of proportion, if 24. houres giue 23. minuts of declination, what will 12. houres giue &c. I multiply and deuide, and finde it to be 11. min. 30. sec. the Sunnes declination in 12. houres motion to be added to the declination of the 20. day, being the Sunnes going from the Equator, or for the poynts of the Compasse, I may say,

## The Seamans Secrets.

If 32. paynts give 22. min. of declination, what will 16. paynts give, which is the distance between South and North? I multiply and divide as the rule of proportion requireth, and find that 16. paynts give 11. min. the Sunnes declination, in moving through 16. paynts of the Compasse, which is to be added to the declination of the 20. day, because the Sunne goeth from the Equator, so I conclude the declination to be 3. d. 52. min. the Sun being North the 20. of March.

his worke  
30. seconds  
omitted.

ho.	ms.	ho.
24	23	12
	12	
<hr/>		
44	2	
22	2	54 (11
	24	4
<hr/>		
264	2	

po.	m.	po.	m.
32	22	16	11
	16		
<hr/>			
	3		
132	2	52	(11
22	2	2	
	3		
<hr/>			
352			

Being West from the Meridian of London 90. degrees of longitude, I desire to know the Suns declination when the Sun is upon the Meridian the 20. of March 1625. I must here consider that 90. deg. of longitude make 6. houres of time, for every houre containeth 15. deg. whereby I know that when the Sunne is South at London, he is but East from me, for when it is 12. of the clocke at London, it is but 6. of the clocke in the morning with me, and when it is 12. of the clocke with me, it is then 6. of the clocke in the afternoone at London: therefore I must seeke for the declination of the Sunne at 6. of the clocke in the afternoone, and that is the meridionall declination which I must use being 90. deg. West from London, which to doe, the last example doth sufficiently teach you, whereby you may easily gather the perfect notice of whatsoever is requisite in any of these kinde of obseruations, if you reade with the eye of reason, and labour to vnderstand with iudgement that which you reade.

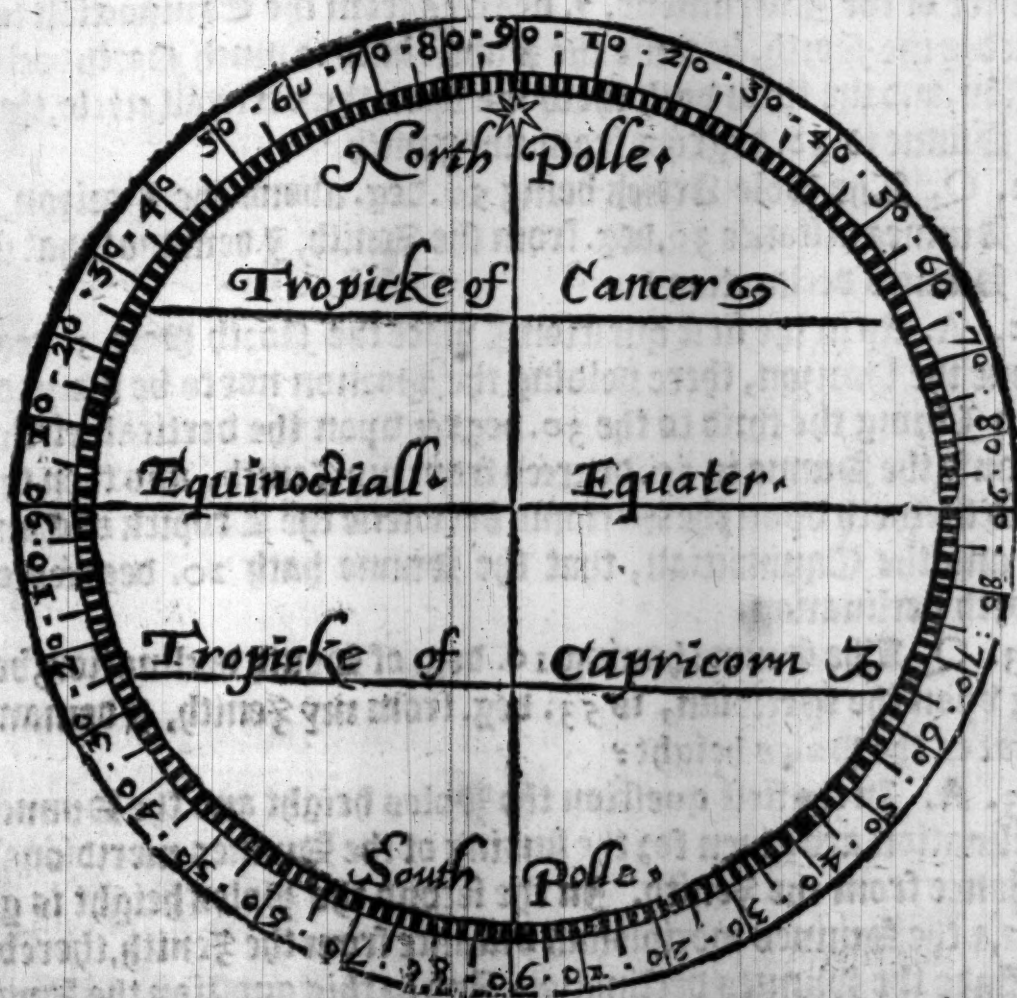
Example. The day and yeare proposed being the 20. of March 1625. declination the 3. d. 59. min. the next day the 21. of March 4. d. 22. min. Deduction made, resteth 23. min. the proportionall part to be found for 90. deg. West, or 6. houres of time. Say if 24. houres give 23. What 6. houres? Facit 5. min. 18. seconds, which



## The Seamans Secrets.

which being that the declination encreaseeth, adde 5. min. 18. sec. to the declination for the day preferred: that totall is the meridionall declination for 90. deg. of westerly longitude from the Meridian of London.

There is another way most excellent for the finding of the Sunnes declination at all times, that is to search by the Ephemerides the Sunnes true place in the Eclipticke for any time purposed whatsoener, and then by the Tables of Sinus the declination is thus knowne. Multiplie the Sinus of the Sunnes longitude from the Equinoctiall points of Aries or Libra, to which soever he is nearest, by the Sinus of the Suns greatest declination, and deuide the product by the whole Sinus, and the arke of the quotient is the declination desired: but because Seamen are not acquainted with such calculations, I therfore omit to speake further thereof, sith this plaine way before taught is sufficient for their purpose.



# The Seamans Secrets.

## The vse of this Instrument.

**B**y this instrument you may sufficiently vnderstand, the reasons of what soeuer is before spoken for the finding of the Poles eleuation, or the latitude of your being: into the consideration whereof, because the young practiser may the better enter, I thinke it not amisse by a few examples to expresse the necessary vse thereof.

1. Q. The Sunne being season degrees of North declination, and the Pole Articke being 45. degrees above the Horizon, I demand what will be the Sunnes Meridionall distance from my Zenith?

1. A. First I turne the Horizon vntill I bring the North Pole to be 45. degrees above the same, there holding the Horizon not to be moued, I then bring the thrid that is fastened to the Center of the Instrument, 7. degrees from the Equinoctiall towards the North, because the Sunne hath so much North declination, and the thrid doth shew me vpon the verticall circle, that the Sunne is 38. degrees from my Zenith.

2. Q. The Pole Artick being 50. deg. above the Horizon, & the Sunnes distance 30. deg. from the Zenith, I demand what is the Sunnes declination?

2. A. As in the first question I place the North Pole 5. deg. above the Horizon, there holding the Horizon not to be moued, then I bring the thrid to the 30. degree vpon the verticall circle, because the Sunne is 30. degrees from my Zenith, and then the thrid sheweth vpon the Meridian betwene the Tropick of Cancer and the Equinoctiall, that the Sunne hath 20. degrees of North declination.

3. Q. The Sunne hauing 10. deg. of South declination, being vpon the Meridian, is 53. deg. from my Zenith, I demand what is the Poles height?

3. A. In the first question the Poles height and the Sunnes declination are giuen for the finding of the Sunnes meridionall distance from the Zenith. In the second the Poles height is giuen, & the Sunnes meridionall distance from the Zenith, thereby to finde the Sunnes declination. And in this question the Sunne



## The Seamans Secrets.

declination and meridionall distance is given for the finding of the Poles height. I therefore bring the thrid fastned in the Center of the Instrument 10. degrees South from the Equator, betwene the Equinoctiall and the Tropick of Capricorne, there holding the thrid not to be moved, I then turne to the Horizon untill I bring the 53. degree of the vertical circle vnder the thrid, and then the Horizon sheweth me, that the North Pole is 43. degrees above the same.

4. Q. The Sunne hauing 12. degrees of South declination, and being vpon the Meridian South from me, is 30. degrees above the Horizon, I demand how farre the Sunne is from my Zenith, how much the Equinoctiall is above the Horizon, and what is the Poles height?

4. A. First I bring the thrid to the place of the Sunnes declination as before, there holding it not to be moved, then I turne the Horizon untill I bring it to be 30. deg. vnder the thrid, and then the thrid sheweth me that the Sunne is 60. deg. from my Zenith, and the Horizon sheweth that the Equinoctiall is 42. deg. above the same, and that the North Pole is also elevated 48. deg. above the Horizon. Although these questions are so very easie and plaine, as that they may readily be answered by memory, yet because the reasons how they are answered may the better appeare, is the cause wherefore they are demanded, and in this sort answered, onely for the benefit of such as are not altogether expert in these practises, that thereby they might likewise frame vnto themselves questions of other varietie, and so gather thereby the more sufficient iudgement in this part of Navigation.

What is the Zenith?

The Zenith is that pike or point in the heavens which is directly ouer your head, from whence a line falling perpendicularly, will touch the place of your being, & so passe by the Center of the Sphere, and this line may be called the Axis of the Horizon, and the Zenith the Pole of the same being 90. d. from all parts thereof, as by the former figure may most plainly appeare.

*The use of the Regiment.*



Orasmuch as the Poles height cannot be obserued by the Sunne, vnlesse the Sunnes true declination bee knowne, I haue therefore carefully calculated these Tables or Regiment, out of *O-riganus*, for the yeare 1625. 6. 7. and 8. which will serue vntill the yeare 1644. without further correction: and because there may grow no error by mistaking the yeares, I haue ouer euery Moneth written the yeare of the Lord, in which the declination of the same Moneth is to be vsed, therefore when in any yeare and Moneth you seeke the Sunnes declination, first looke for the Moneth, and there you shall find 4. of those Moneths, which are the Moneths between the leape yeares, then looke ouer each of those Moneths, vntill you finde the yeare of the Lord, wherein you seeke the declination, and directly vnder that yeare is the Moneth wherein you must seeke the Suns declination: Example, 1626. the tenth day of Feb. I would know the Suns declination, first I seeke out February, & vnder the second yeare I see the yeare 1626. therefore this is my Moneth, against the tenth day of which Moneth I find that the Sun hath 10. deg 49. min. of South declination, and after the like manner you must doe in all the

rest as occasion requireth.



# January.

First.		Second.		Third.		Fourth.
1625		1626		1627		1628
1629		1630		1631		1632
1633		1634		1635		1636
1637		1638		1639		1640
1641		1642		1643		1644

D. G. M.

D. G. M.

D. G. M.

D. G. M.

1	21	47
2	21	37
3	21	27
4	21	16
5	21	5
6	20	52
7	20	41
8	20	29
9	20	17
10	20	4
11	19	50
12	19	37
13	19	21
14	19	1
15	18	52
16	18	37
17	18	21
18	18	5
19	17	49
20	17	32
21	17	15
22	16	58
23	16	41
24	16	23
25	16	5
26	15	47
27	15	28
28	15	9
29	14	50
30	14	31

South Declination.

1	21	49
2	21	39
3	21	29
4	21	18
5	21	7
6	20	56
7	20	44
8	20	32
9	20	19
10	20	6
11	19	59
12	19	35
13	19	20
14	19	5
15	18	50
16	18	34
17	18	25
18	18	9
19	17	53
20	17	36
21	17	19
22	17	2
23	16	45
24	16	27
25	16	9
26	15	51
27	15	32
28	15	13
29	14	55
30	14	35
31	14	16

South Declination.

1	21	51
2	21	42
3	21	31
4	21	21
5	21	10
6	20	59
7	20	47
8	20	35
9	20	22
10	20	9
11	19	56
12	19	42
13	19	28
14	19	14
15	18	59
16	18	44
17	18	28
18	18	13
19	17	57
20	17	40
21	17	33
22	17	6
23	16	49
24	16	31
25	16	13
26	15	55
27	15	36
28	15	18
29	14	59
30	14	40
31	14	20

South Declination.

1	21	54
2	21	44
3	21	34
4	21	24
5	21	13
6	21	2
7	20	50
8	20	38
9	20	25
10	20	12
11	19	59
12	19	46
13	19	32
14	19	18
15	19	3
16	18	48
17	18	33
18	18	17
19	18	1
20	17	44
21	17	28
22	17	11
23	16	53
24	16	36
25	16	18
26	16	0
27	15	42
28	15	23
29	15	4
30	14	45
31	14	25

# February.

First.	Second.	Third.	Fourth.
1625	1626	1627	1628
1629	1630	1631	1632
1633	1634	1635	1636
1637	1638	1639	1640
1641	1642	1643	1644
D. G. M.	D. G. M.	D. G. M.	D. G. M.
1 13 51	1 13 56	1 14 00	1 14 15
2 13 31	2 13 36	2 13 40	2 13 55
3 13 9	3 13 15	3 13 20	3 13 35
4 12 50	4 12 55	4 13 0	4 13 14
5 12 29	5 12 34	5 12 39	5 12 54
6 12 8	6 12 14	6 12 19	6 12 33
7 11 48	7 11 53	7 11 58	7 12 12
8 11 26	8 11 31	8 11 36	8 11 50
9 11 5	9 11 10	9 11 15	9 11 29
10 10 43	10 10 49	10 10 54	10 11 7
11 10 21	11 10 27	11 10 32	11 10 45
12 10 0	12 10 5	12 10 10	12 10 23
13 9 36	13 9 43	13 9 48	13 10 1
14 9 15	14 9 21	14 9 26	14 9 39
15 8 53	15 8 58	15 9 4	15 9 16
16 8 30	16 8 36	16 8 42	16 8 53
17 8 8	17 8 14	17 8 19	17 8 31
18 7 45	18 7 51	18 7 56	18 8 8
19 7 22	19 7 28	19 7 33	19 7 45
20 6 59	20 7 5	20 7 10	20 7 22
21 6 36	21 6 42	21 6 47	21 6 58
22 6 13	22 6 19	22 6 24	22 6 35
23 5 50	23 5 56	23 6 1	23 6 12
24 5 27	24 5 32	24 5 38	24 5 48
25 5 3	25 5 9	25 5 15	25 5 24
26 4 40	26 4 46	26 4 51	26 5 0
27 4 16	27 4 22	27 4 28	27 4 37
28 3 53	28 3 58	28 4 4	28 4 13
			29 3 49

South Declination.

South Declination.

South Declination.



# March.

First.	Second.	Third.	Fourth.
1625	1626	1627	1628
1629	1630	1631	1632
1633	1634	1635	1636
1637	1638	1639	1640
1641	1642	1643	1644
D. G. M.	D. G. M.	D. G. M.	D. G. M.

1	3 29
2	3 6
3	2 43
4	2 19
5	1 55
6	1 31
7	1 7
8	0 43
9	0 20
10	0 4
11	0 27
12	0 51
13	1 15
14	1 38
15	2 2
16	2 25
17	2 49
18	3 13
19	3 36
20	3 59
21	4 22
22	4 43
23	5 8
24	5 31
25	5 54
26	6 17
27	6 39
28	7 2
29	7 25
30	7 47

South Declination.  
Equi-  
North Declination.

1	3 35
2	3 11
3	2 48
4	2 24
5	2 0
6	1 37
7	1 13
8	0 49
9	0 26
10	0 3
11	0 21
12	0 45
13	1 9
14	1 33
15	1 56
16	2 20
17	2 43
18	3 7
19	3 30
20	3 53
21	4 15
22	4 39
23	5 3
24	5 26
25	5 49
26	6 12
27	6 34
28	6 56
29	7 19
30	7 41

South Declination.  
nocti-  
North Declination.

1	3 41
2	3 17
3	2 53
4	2 30
5	2 6
6	1 42
7	1 19
8	0 55
9	0 31
10	0 8
11	0 16
12	0 40
13	1 3
14	1 27
15	1 50
16	2 14
17	2 37
18	3 10
19	3 25
20	3 48
21	4 11
22	4 34
23	4 57
24	5 20
25	5 43
26	6 6
27	6 29
28	6 51
29	7 14
30	7 36

South Declination.  
Equi-  
North Declination.

1	3 23
2	3 0
3	2 35
4	2 12
5	1 49
6	1 25
7	1 1
8	0 38
9	0 14
10	0 10
11	0 34
12	0 57
13	1 21
14	1 44
15	2 8
16	2 32
17	2 55
18	3 19
19	3 42
20	4 5
21	4 28
22	4 51
23	5 14
24	5 37
25	6 0
26	6 23
27	6 45
28	7 9
29	7 30
30	7 52

# Aprill.

First.	Second.	Third.	Fourth.
1625	1626	1627	1628
1629	1630	1631	1632
1633	1634	1635	1636
1637	1638	1639	1640
1641	1642	1643	1644
D.G.M.	D.G.M.	D.G.M.	D.G.M.

1	8	31
2	8	53
3	9	15
4	9	36
5	9	58
6	10	19
7	10	40
8	11	1
9	11	22
10	11	42
11	12	3
12	12	22
13	12	43
14	13	2
15	13	22
16	13	42
17	14	1
18	14	19
19	14	38
20	14	56
21	15	15
22	15	33
23	15	50
24	16	8
25	16	25
26	16	42
27	16	58
28	17	14
29	17	30
30	17	46

North Declination.

1	8	25
2	8	48
3	9	9
4	9	31
5	9	53
6	10	14
7	10	35
8	10	56
9	11	17
10	11	37
11	11	58
12	12	18
13	12	38
14	12	58
15	13	17
16	13	37
17	13	56
18	14	15
19	14	34
20	14	52
21	15	10
22	15	28
23	15	46
24	16	3
25	16	20
26	16	37
27	16	54
28	17	11
29	17	26
30	17	42

North Declination.

1	8	20
2	8	42
3	9	4
4	9	26
5	9	47
6	10	9
7	10	30
8	10	51
9	11	12
10	11	32
11	11	53
12	12	13
13	12	33
14	12	53
15	13	11
16	13	32
17	13	51
18	14	10
19	14	29
20	14	48
21	15	6
22	15	24
23	15	41
24	15	59
25	16	16
26	16	33
27	16	49
28	17	7
29	17	23
30	17	38

North Declination.

1	8	37
2	8	59
3	9	21
4	9	42
5	10	4
6	10	25
7	10	46
8	11	7
9	11	27
10	11	48
11	12	8
12	12	28
13	12	48
14	13	7
15	13	27
16	13	47
17	14	6
18	14	25
19	14	43
20	15	1
21	15	20
22	15	37
23	15	55
24	16	12
25	16	29
26	16	46
27	17	3
28	17	19
29	17	35
30	17	50



# May.

First.	Second.	Third.	Fourth.
1625	1626	1627	1628
1629	1630	1631	1632
1633	1634	1635	1636
1637	1638	1639	1640
1641	1642	1643	1644

D. G. M.

D. G. M.

D. G. M.

D. G. M.

1	18	2
2	18	17
3	18	32
4	18	46
5	19	0
6	19	14
7	19	28
8	19	41
9	19	54
10	20	7
11	20	19
12	20	31
13	20	42
14	20	53
15	21	4
16	21	15
17	21	25
18	21	35
19	21	44
20	21	53
21	22	2
22	22	10
23	22	18
24	22	25
25	22	32
26	22	39
27	22	45
28	22	51
29	22	57
30	23	2

North Declination.

1	17	58
2	18	13
3	18	28
4	18	43
5	18	57
6	19	11
7	19	25
8	19	38
9	19	51
10	20	3
11	20	16
12	20	28
13	20	39
14	20	51
15	21	2
16	21	12
17	21	22
18	21	32
19	21	42
20	21	51
21	22	0
22	22	8
23	22	16
24	22	23
25	22	31
26	22	37
27	22	44
28	22	50
29	22	56
30	23	1
31	23	6

North Declination.

1	17	54
2	18	10
3	18	24
4	18	39
5	18	54
6	19	8
7	19	21
8	19	35
9	19	48
10	20	0
11	20	13
12	20	25
13	20	37
14	20	48
15	20	59
16	21	10
17	21	20
18	21	30
19	21	40
20	21	49
21	21	58
22	22	6
23	22	14
24	22	22
25	22	29
26	22	36
27	22	42
28	22	48
29	22	54
30	22	59
31	23	4

North Declination.

1	18	6
2	18	21
3	18	36
4	18	50
5	19	4
6	19	18
7	19	32
8	19	45
9	19	57
10	20	10
11	20	22
12	20	34
13	20	45
14	20	56
15	21	7
16	21	18
17	21	28
18	21	37
19	21	46
20	21	55
21	22	4
22	22	12
23	22	20
24	22	27
25	22	34
26	22	41
27	22	47
28	22	53
29	22	58
30	23	3
31	23	8

# June.

First.	Second.	Third.	Fourth.
1625	1626	1627	1628
1629	1630	1631	1632
1633	1634	1635	1636
1637	1638	1639	1640
1641	1642	1643	1644
D. G. M.	D. G. M.	D. G. M.	D. G. M.

1	23	11
2	23	15
3	23	18
4	23	21
5	23	24
6	23	26
7	23	28
8	23	30
9	23	31
10	23	31
11	23	31
12	23	31
13	23	31
14	23	30
15	23	28
16	23	26
17	23	24
18	23	21
19	23	18
20	23	15
21	23	11
22	23	7
23	23	2
24	22	57
25	22	51
26	22	45
27	22	39
28	22	32
29	22	25
30	22	18

North  
Tro-  
Declination.

1	23	10
2	23	14
3	23	17
4	23	21
5	23	23
6	23	26
7	23	28
8	23	29
9	23	30
10	23	31
11	23	31
12	23	31
13	23	31
14	23	30
15	23	29
16	23	27
17	23	25
18	23	22
19	23	19
20	23	16
21	23	12
22	23	8
23	23	3
24	22	58
25	22	53
26	22	47
27	22	41
28	22	34
29	22	27
30	22	20

North  
pi-  
Declination.

1	23	9
2	23	13
3	23	17
4	23	20
5	23	23
6	23	25
7	23	27
8	23	29
9	23	30
10	23	31
11	23	31
12	23	31
13	23	31
14	23	30
15	23	29
16	23	27
17	23	25
18	23	23
19	23	20
20	23	17
21	23	13
22	23	9
23	23	4
24	22	59
25	22	54
26	22	48
27	22	42
28	22	36
29	22	29
30	22	22

North  
cus.  
Declination.

1	23	12
2	23	16
3	23	19
4	23	22
5	23	25
6	23	27
7	23	29
8	23	30
9	23	30
10	23	31
11	23	31
12	23	31
13	23	30
14	23	29
15	23	28
16	23	26
17	23	23
18	23	21
19	23	17
20	23	14
21	23	10
22	23	5
23	23	0
24	22	55
25	22	50
26	22	44
27	22	37
28	22	31
29	22	23
30	22	16



July.

First.		Second.		Third.		Fourth.
1625		1626		1627		1628
1629		1630		1631		1632
1633		1634		1635		1636
1637		1638		1639		1640
1641		1642		1643		1644
D. G. M.		D. G. M.		D. G. M.		D. G. M.
1 22 10	North Declination.	1 22 12	North Declination.	1 22 14	North Declination.	1 22 8
2 22 2		2 22 4		2 22 6		2 22 0
3 21 53		3 21 55		3 21 57		3 21 51
4 21 44		4 21 46		4 21 49		4 21 42
5 21 35		5 21 37		5 21 40		5 21 32
6 21 25		6 21 28		6 21 30		6 21 22
7 21 15		7 21 18		7 21 20		7 21 12
8 21 5		8 21 7		8 21 10		8 21 2
9 20 54		9 20 56		9 20 59		9 20 51
10 20 43		10 20 45		10 20 48		10 20 40
11 20 31		11 20 34		11 20 37		11 20 28
12 20 19		12 20 22		12 20 25		12 20 16
13 20 7		13 20 10		13 20 13		13 20 4
14 19 55		14 19 58		14 20 2		14 19 51
15 19 42		15 19 45		15 19 49		15 19 38
16 19 29		16 19 32		16 19 36		16 19 25
17 19 15		17 19 18		17 19 22		17 19 2
18 19 1		18 19 5		18 19 9		18 18 58
19 18 47		19 18 51		19 18 55		19 18 43
20 18 33		20 18 36		20 18 41		20 18 29
21 18 18		21 18 22		21 18 26		21 18 14
22 18 3		22 18 7		22 18 11		22 17 59
23 17 48		23 17 51		23 17 57		23 17 43
24 17 32		24 17 36		24 17 40		24 17 28
25 17 16		25 17 20		25 17 24		25 17 12
26 17 0		26 17 4		26 17 9		26 16 56
27 16 43		27 16 47		27 16 52		27 16 39
28 16 27		28 16 31		28 16 36		28 16 22
29 16 10		29 16 14		29 16 19		29 16 5
30 15 52		30 15 57		30 16 2		30 15 48
31 15 35		31 15 39		31 15 44		31 15 30

# August.

First.		Second.		Third.		Fourth.
1625		1626		1627		1628
1629		1630		1631		1632
1633		1634		1635		1636
1637		1638		1639		1640
1641		1642		1643		1644
D. G. M.		D. G. M.		D. G. M.		D. G. M.
1 15 17	North Declination.	1 15 21	North Declination.	1 15 26	North Declination.	1 15 12
2 14 59		2 15 4		2 15 8		2 14 54
3 14 41		3 14 45		3 14 50		3 14 36
4 14 22		4 14 27		4 14 31		4 14 47
5 14 4		5 14 8		5 14 13		5 13 59
6 13 45		6 13 49		6 13 54		6 13 39
7 13 25		7 13 30		7 13 25		7 13 20
8 13 5		8 13 10		8 13 15		8 13 1
9 12 47		9 12 51		9 12 56		9 12 41
10 12 27		10 12 32		10 12 36		10 12 21
11 12 7		11 12 12		11 12 16		11 12 1
12 11 47		12 11 51		12 11 56		12 11 41
13 11 26		13 11 31		13 11 36		13 11 20
14 11 6		14 11 11		14 11 16		14 11 0
15 10 45		15 10 51		15 10 55		15 10 39
16 10 24		16 10 29		16 10 34		16 10 18
17 10 13		17 10 8		17 10 13		17 9 57
18 9 42		18 9 47		18 9 52		18 9 36
19 9 20		19 9 25		19 9 31		19 9 14
20 8 59		20 9 4		20 9 9		20 8 53
21 8 37		21 8 42		21 8 48		21 8 31
22 8 15		22 8 21		22 8 26		22 8 9
23 7 53		23 7 58		23 8 4		23 7 47
24 7 31		24 7 37		24 7 42		24 7 25
25 7 9		25 7 15		25 7 20		25 7 3
26 6 47		26 6 52		26 6 57		26 6 40
27 6 24		27 6 30		27 6 35		27 6 18
28 6 2		28 6 8		28 6 12		28 5 55
29 5 39		29 5 45		29 5 50		29 5 33
30 5 16		30 5 22		30 5 27		30 5 10
31 4 58		31 4 59		31 5 4		31 4 47



# September.

First.		Second.		Thrd.		Fourth.	
1625		1626		1627		1628	
1629		1630		1631		1632	
1633		1634		1635		1636	
1637		1638		1639		1640	
1641		1642		1643		1644	
D. G. M.		D. G. M.		D. G. M.		D. G. M.	
1	4 36	1	4 36	1	4 41	1	4 24
2	4 18	2	4 13	2	4 19	2	4 1
3	3 44	3	3 50	3	3 55	3	3 38
4	3 21	4	3 27	4	3 32	4	3 15
5	2 54	5	3 4	5	3 9	5	2 52
6	2 35	6	2 40	6	2 46	6	2 28
7	2 17	7	2 17	7	2 23	7	2 5
8	1 44	8	1 54	8	1 59	8	1 41
9	1 35	9	1 31	9	1 36	9	1 18
10	1 7	10	1 7	10	1 13	10	0 55
11	0 33	11	0 43	11	0 49	11	0 31
12	0 14	12	0 20	12	0 26	12	0 35
13	0 10	13	0 4	13	0 2	13	0 16
14	0 33	14	0 27	14	0 22	14	0 40
15	0 56	15	0 51	15	0 45	15	1 3
16	1 20	16	1 14	16	1 9	16	1 27
17	1 43	17	1 38	17	1 32	17	1 50
18	2 7	18	2 1	18	1 56	18	2 14
19	2 31	19	2 25	19	2 19	19	2 37
20	2 54	20	2 48	20	2 43	20	3 0
21	3 17	21	3 11	21	3 6	21	3 24
22	3 41	22	3 35	22	3 30	22	3 47
23	4 4	23	3 58	23	3 53	23	4 11
24	4 28	24	4 22	24	4 16	24	4 34
25	4 51	25	4 45	25	4 40	25	4 57
26	5 14	26	5 8	26	5 3	26	5 20
27	5 37	27	5 32	27	5 26	27	5 44
28	6 0	28	5 55	28	5 49	28	6 7
29	6 23	29	6 18	29	6 12	29	6 29
30	6 46	30	6 41	30	6 35	30	6 22

North Declination.

Equi-

South Declination.

North Declination.

nocti-

South Declination.

North Declination.

all.

South Declination.

# October.

First.	Second.	Third.	Fourth.
1625	1626	1627	1628
1629	1630	1631	1632
1633	1634	1635	1636
1637	1638	1639	1640
1641	1642	1643	1644
D.G.M.	D.G.M.	D.G.M.	D.G.M.
1 7 9	1 7 4	1 6 58	1 7 15
2 7 32	2 7 26	2 7 21	2 7 38
3 7 54	3 7 49	3 7 44	3 8 1
4 8 17	4 8 12	4 8 6	4 8 23
5 8 39	5 8 34	5 8 28	5 8 54
6 9 2	6 8 56	6 8 51	6 9 8
7 9 24	7 9 18	7 9 13	7 9 30
8 9 46	8 9 40	8 9 35	8 9 52
9 10 8	9 10 2	9 9 57	9 10 14
10 10 29	10 10 24	10 10 19	10 10 35
11 10 51	11 10 46	11 10 41	11 10 57
12 11 12	12 11 7	12 11 2	12 11 18
13 11 34	13 11 28	13 11 23	13 11 39
14 11 55	14 11 49	14 11 44	14 12 0
15 12 15	15 12 11	15 12 5	15 12 21
16 12 36	16 12 31	16 12 26	16 12 42
17 12 57	17 12 52	17 12 47	17 13 2
18 13 17	18 13 11	18 13 6	18 13 23
19 13 37	19 13 32	19 13 27	19 13 42
20 13 57	20 13 52	20 13 47	20 14 2
21 14 16	21 14 12	21 14 7	21 14 22
22 14 36	22 14 39	22 14 26	22 14 41
23 14 55	23 14 50	23 14 46	23 15 0
24 15 14	24 15 10	24 15 5	24 15 19
25 15 33	25 15 28	25 15 24	25 15 38
26 15 51	26 15 47	26 15 42	26 15 56
27 16 9	27 16 5	27 16 0	27 16 14
28 16 27	28 16 23	28 16 19	28 16 32
29 16 45	29 16 41	29 16 36	29 16 49
30 17 2	30 16 58	30 16 54	30 17 7

South Declination.

South Declination.

South Declination.



# November.

First.		Second.		Third.		Fourth.
1625		1626		1627		1628
1629		1630		1631		1632
1633		1634		1635		1636
1637		1638		1639		1640
1641		1642		1643		1644

D. G. M.                      D. G. M.                      D. G. M.                      D. G. M.

1	17	36
2	17	52
3	18	8
4	18	24
5	18	40
6	18	55
7	19	10
8	19	24
9	19	38
10	19	52
11	20	5
12	20	18
13	20	31
14	20	43
15	20	55
16	21	6
17	21	17
18	21	28
19	21	38
20	21	48
21	21	58
22	22	7
23	22	15
24	22	23
25	22	31
26	22	38
27	22	45
28	22	51
29	22	57
30	23	3

South Declination.

1	17	32
2	17	48
3	18	5
4	18	20
5	18	36
6	18	51
7	19	6
8	19	21
9	19	35
10	19	48
11	20	2
12	20	15
13	20	28
14	20	40
15	20	52
16	21	4
17	21	15
18	21	26
19	21	36
20	21	46
21	21	56
22	22	4
23	22	13
24	22	21
25	22	29
26	22	36
27	22	43
28	22	50
29	22	55
30	23	1

South Declination.

1	17	28
2	17	44
3	18	1
4	18	17
5	18	32
6	18	47
7	19	2
8	19	17
9	19	31
10	19	45
11	19	59
12	20	12
13	20	25
14	20	37
15	20	49
16	21	1
17	21	12
18	21	23
19	21	33
20	21	43
21	21	53
22	22	2
23	22	11
24	22	19
25	22	27
26	22	35
27	22	42
28	22	48
29	22	54
30	23	0

South Declination.

1	17	40
2	17	57
3	18	13
4	18	28
5	18	44
6	18	59
7	19	13
8	19	28
9	19	42
10	19	56
11	20	9
12	20	22
13	20	34
14	20	46
15	20	58
16	21	9
17	21	20
18	21	31
19	21	41
20	21	51
21	22	10
22	22	9
23	22	17
24	22	25
25	22	33
26	22	40
27	22	47
28	22	53
29	22	59
30	23	4

# December.

First.			Second.			Third.			Fourth.		
1625			1626			1627			1628		
1629			1630			1631			1632		
1633			1634			1635			1636		
1637			1638			1639			1640		
1641			1642			1643			1644		
D. G. M.			D. G. M.			D. G. M.			D. G. M.		
1 23 8			1 23 6			1 23 5			1 23 9		
2 23 12			2 23 11			2 23 10			2 23 13		
3 23 16			3 23 15			3 23 14			3 23 17		
4 23 20			4 23 19			4 23 18			4 23 21		
5 23 23			5 23 22			5 23 21			5 23 24		
6 23 25			6 23 25			6 23 24			6 23 26		
7 23 28			7 23 27			7 23 27			7 23 28		
8 23 29			8 23 29			8 23 29			8 23 30		
9 23 30			9 23 30			9 23 30			9 23 31		
10 23 31			10 23 31			10 23 31			10 23 31		
11 23 31			11 23 31			11 23 31			11 23 31		
12 23 31			12 23 31			12 23 31			12 23 31		
13 23 30			13 23 31			13 23 31			13 23 30		
14 23 29			14 23 30			14 23 30			14 23 29		
15 23 28			15 23 28			15 23 29			15 23 27		
16 23 26			16 23 26			16 23 27			16 23 25		
17 23 23			17 23 24			17 23 24			17 23 22		
18 23 20			18 23 21			18 23 22			18 23 19		
19 23 17			19 23 17			19 23 18			19 23 15		
20 23 13			20 23 14			20 23 14			20 23 11		
21 23 8			21 23 9			21 23 10			21 23 7		
22 23 3			22 23 4			22 23 6			22 23 2		
23 22 58			23 22 59			23 23 0			23 22 56		
24 22 52			24 22 53			24 22 55			24 22 50		
25 22 46			25 22 47			25 22 49			25 22 44		
26 22 39			26 22 40			26 22 42			26 22 37		
27 22 32			27 22 33			27 22 35			27 22 30		
28 22 24			28 22 26			28 22 28			28 22 21		
29 22 16			29 22 18			29 22 20			29 22 14		
30 22 7			30 22 9			30 22 12			30 22 5		
31 22 0			31 22 1			31 22 3			31 22 56		

South

Tro-

Declination.

South

picus.

Declination.

South

Cancer.

Declination.



## The Seamans Secrets.

What is the Chart?

**T**he Sea Chart is a speciall instrument for the Seamans vse, whereby the hidzographicall description of the Ocean Seas, with the answering geographicall limits of the earth, are supposed to be in such sort giuen, as that the longitudes and latitudes of all places, with the true distance and course betwene place and place, might be truely knowne. But because there is no proportionable agrément betwene a Globus superficies, and a plaine superficies, therefore a Chart doth not expresse that certaintie of the premisses which is thereby pretended to be giuen, for things are best described vpon bodies agreeable to their owne forme. And whereas in the true nature of the Sphere, there can be no parallels described but the East and West courses onely, the rest of the courses being concurred lines, ascendent toward the Poles, the Meridians all concurring and ioyning together in the Poles, notwithstanding in the Sea Chart all those courses are described as parallells, without any diuersitie, alteration or distinction to the contrary, whereby the instrument is apparantly faultie: yet it cannot be denyed but Charts for short courses are to very good purpose for the Pilots vse, and in long courses be the distance neuer so farre if the Pilot returne by the same course, whereby in the first he prosecuted his voyage, his Chart will be without error, as an instrument of very great commoditie, but if he returne by any other way, then by that which he went forth, the imperfections of the Chart will then appeare to be very great, especially, if the voyage be long, or that the same be in the North parts of the world, the farther towards the North, the more imperfect: therefore there is no instrument answerable to the Globe or paradoxall Chart, for all courses and climats whatsoeuer, by whom all declared truth is most plentifully manifested, as shall hereafter at large be declared, but for the coasting of any Shore or Country, or for short voyages, there is no instrument more conuenient for the Seamans vse, then the well described Sea Chart.

What is the vse of the Sea Chart?

**B**y the directions of the Sea Chart the skilfull Pilot conueyeth his Shippe, from place to place, by such courses as by the

## The Seamans Secrets.

Chart are made known vnto him, together with the helpe of his Compasse or Crosse Staffe, as befoze is shewed, for the Crosse Staffe, the Compasse, and the Chart, are so necessarily ioyned together, as that the one may not well be without the other in the execution of the practises of Navigation: for as the Chart sheweth the courses, so doth the Compasse direct the same, & the Crosse Staffe by every particular obserued latitude doth confirme the truth of such courses, and also giue the certaine distance that the Ship hath sayled vpon the same.

And in the vse or vnderstanding of the Sea Chart, there are five things chiefly to be regarded.

The first is, that the Countries or geographie of the Chart be knowne, with every Cape, Promontory, Port, Hauen, Bay, Sands, Rocks, and dangers therein contained.

Secondly, that the lines drawne vpon the Chart, with their seuerall properties be likewise vnderstood.

Thirdly, that the latitudes of such places as are within the Chart be also knowne, as by the Chart they are expressed.

Fourthly, that you be able to measure the distances betwene place and place vpon the Chart.

And fifthly, the Seaman must be able by his Chart to know the true courses betwene any Isles, Continents, or Capes whatsoever, for by these five diuersities, the Chart is to be vsed in the skill of Navigation.

How is the latitude of places knowne by the Chart?

The latitude is thus found by the Chart, vpon the place whose latitude you desire to know, set one foote of your Compasses, then stretch the other foote to the next East & West line (for that line is your director) keeping that foote still vpon the same line, moue your hand and Compasses East or West, as occasion requireth, vntill you bring the Compasses to the graduated Meridian, & there that foote of the Compasses which stood vpon the place whose latitude you would know, doth shew the latitude of the same place.

How



## The Seamans Secrets.

How is the course betweene place and place knowne?

**W**hen there are two places assigned, the course betweene which you desire to know, set one foote of your Compasses vpon one of the places, then by discretion consider the lines that lead toward the other place, stretching the other foote of the Compasses to one of those lines, & so that part of the line which is nearest to you, keeping that foote still vpon the same line, moue your hand and Compasses toward the other place, and see whether the other foote of the Compasses that stood vpon the other place, doe by this direction touch the second place, which if it doe, then that line whereupon you kept the one foote of your Compasses, is the course betweene those places: but if it touch not the place, you must by discretion search vntill you finde a line, whereupon keeping the one foote of the Compasses, will lead the other foote directly from the one place to the other, for that is the course betweene those two places.

How is the distance of places found vpon the Chart?

**I**f the places be not farre asunder, stretch a paire of Compasses betweene them, setting the one foote of the Compasses vpon one of the places, and the other vpon the other place, then not altering the Compasses, set them vpon the graduated Meridian of your Chart, and allowing 20. leagues for euery degree, that is contained betweene the two foete of your Compasses, the distance desired is thereby knowne: if betweene the places there be 5. degrees, then they are 100. leagues asunder, &c. But if the distance betweene the places be so great, as that the Compasses cannot reach betweene them, then take out 5. degrees with your Compasses, which is 100. leagues, and therewith you may measure the distance as practise will teach you. There is also in euery Chart a scale of leagues laid downe, whereby you may measure distances, as commonly is vsed.

How doth the Pilot order these matters, thereby to conduct his Ship from place to place.

**T**he Pilot in the execution of this part of Navigation, doth with carefull regard consider three especiall things, whereupon the full practises are grounded.

## The Seamans Secrets.

1. Of which the first is, the good obseruation of his latitude, which how it may be knowne is befoze sufficiently expressed.
2. The second is a carefull regard vnto his steredge, with very diligent examination of the truth of his Compasse, that it be without variation or other impediments.
3. And the third is a carefull consideration of the number of leagues that the Ship sayleth in euery houre or watch, to the nearest estimation that possibly he can giue, for any two of these three practises being truely giuen, the third is thereby likewise knowne.

As by the Course and height the distance is manifested, by the distance and Course the height is knowne: by the height and distance the Course is giuen, of which three things the Pilot hath onely his height in certaine: the Course is somewhat doubtfull, and the distance is but barely supposed, notwithstanding from his altitude and Course he concludeth the truth of his practise, proceeding in this sort.

First he considereth in what latitude the place standeth from whence he shapeth his Course, which for an example shall be the Lyzart standing in 50. degrees of septentrionall latitude, then directing his Course S. W. sayleth 3. or 4. dayes or longer in such thick weather, as that he is not able to make any obseruation of the Poles altitude, in which time he omitteth not to keepe an account how many leagues the ship hath sayled vpon that Course as nere as he can gesse, which number of leagues in this example shall be 100. according to his iudgement: then hauing conuenient weather, he obserueth in what latitude he is, and findeth himselfe to be in 47. degrees, now with his Compasses he taketh the distance of 100. leagues, which is the quantitie of the Ships run by his supposition, and then setting one foote of the Compasses vpon the Lyzart, which is the place from whence he began his Course, and directly S. W. from the same he setteth the other point of the Compasses, by the direction of another paire of Compasses, in such sort as Courses are found, and there he maketh a prick for the place of his Ships being, according to his reckoning and Course.

And now searching whether it doe agree with his height, (for the height, course, and distance must all agree together) he findeth  
that



## The Seamans Secrets.

that his prick standeth in 46. degrees, 26. minutes, but it should stand in 47. degrees, to agree with his obseruation. Therefore perceiuing that he hath giuen the ship too much way, he bringeth his course and obserued altitude to agree, and then he seeth that his ship hath sayled but 85. leagues, and there he layeth downe a prick for the true place of his ships being, according to his course and latitude, for so by his course and height he findeth the truth of his distance, & reprocoueth his supposed accompt to be 15. leagues too much: and after this sort he proceedeth from place to place, vntill he arrive vnto his desired Port: which is a conclusion infallible, if there be no other impediments, (whereof there hath not bene good consideration had) which may breed error, for from such negligence there may arise many inconueniences.

What may those impediments be?

**B**y experience at the Sea we finde many impediments that so disturb the expected conclusion of our practise, as that they agree not with the true positions of art. For, first it is a matter not common to haue the winde so beneficiall, as that a ship may sayle thereby, betweene any two assigned places vpon the direct course, but that by the contrarietie of winds, she may be constrained to traues vpon all points of the Compasse, the nature whereof I haue before sufficiently expressed.

Secondly, although the wind may in some sort fauour, yet the ship may haue such a leward condition, as that she may make her way 2. or 3. points from her capping.

Thirdly, the steredge may be so disorderly handled, as that thereby the Pilot may be abused.

And lastly, the Compasse may be so varied, as that the Pilot may likewise thereby be drawne into error, at all which things and many more, as the nature of his sayling, whether before the wind, quartering or by a bowling, or whether with losse or losse sayles, with the benefits or hinderances of the Sea, tides, gates, streames, and forced let thereof, &c. Of all which things (I say) the skilfull Pilot must haue carefull consideration, which are better learned by practise then taught by pen, for it is not possible that any man can be a good and sufficient Pilot or skilfull

Seaman.

## The Seamans Secrets.

Seaman, but by painefull and diligent practise, with the assistance of art, whereby the famous pylot may be esteemed worthy of his profession, as a member meete for the Commonwealth.

And now having sufficiently shewed you the ordering of your Chart, for the execution of the skill of Navigation, and being also desirous that you should effectually understand the full nature and vse of the same: I thinke it good by a few questions to give you an occasion to exercise your selfe, in the perfect accomplishment of such conclusions as are by this excellent and commodious instrument to be perfozmed.

Necessary questions for the better vnderstanding of the commodious vse of the Chart.

1. Q. If I sayle 70. leagues vpon the Southwest course, I demand how many degrees I shall lay or depresse the pole?

A. The difference will be 2. degrees, 30. minutes.

2. Q. If in sayling West Northwest I raise the pole 3. degrees, 30. minutes, I demand how many leagues I haue sayled?

A. The distance sayled, is 180. leagues.

3. Q. If in sayling 180. leagues betweene West and Nor. I raise the pole 3. degrees, I demand vpon what course I haue sayled, and how farre I am from the Meridian from whence I began that course?

A. The course sayled is N. W. b. W. and the distance from the Meridian is 90. leagues.

4. Q. If in sayling 154. leagues I be 80. leagues West from the Meridian from whence I began my course, I demand vpon what point of the Compasse I haue sayled, and how much I haue raised the pole?

A. The course is N. W. b. N. and the pole is raised 6. degrees.

5. Q. If I sayle N. W. vntill I be 50. leagues from the Meridian, where I began my course. I demand how many leagues I haue sayled, and how much the pole is raised?

A. The distance sayled is 71. leagues, and the pole is raised 2. degrees, 32. minutes.



## The Seamans Secrets.

6. Q. If in sayling *N. N. W.* I doe in 30. houres raise 2. degrees, how many degrees should I haue raised the pole, if the same motion had beene North and by West?

A. You should haue raised 5. degrees.

7. Q. A ship sayling towards the West, for every 80. leagues that she sayleth in her Course, shee departeth from the Meridian from whence she began the same Course 45. leagues, I demand vpon what point of the Compasse, & how many leagues she hath sayled, in raising the pole 5. degrees?

A. She hath sayled North-west by North 120. leagues.

8. Q. A pylote sayling toward the West 100. leagues, hath forgotten his Course, yet thus much he knoweth, that if he had sayled vpon such a course, as that in 160. leagues sayling he would haue raised the pole 3. degrees, he should then haue beene twice as farre from the Meridian as now he is, and should also haue beene  $\frac{1}{2}$  degrees further to the Northward then now he is, I would now know what course he hath sayled, how many leagues, and how farre he is seperated from the Meridian from whence he began the said Course.

A. Shee hath sayled 88. leagues North-west by west, and is 73. leagues from the Meridian nearest.

9. Q. Two shippes departing from one place, the one sayling 145. leagues towards the West, hath raised the pole 4. degrees, and the other hath raised the pole 7. degrees, and is 95. leagues West from the Meridian of the place from whence he began his Course, I demand by what course the said ship hath sayled, how farre they be asunder, and by what course they may meete?

A. The first ship hath sayled North-west by west, the second hath sayled North-west by north 170. leagues, they are asunder 65. leagues, and the Course betwene them is North northeast, and South southwest.

10. Q. Two ships sayling from one place, the one in sayling 180. leagues, is to the Eastward of the Meridian where he began his course 150. leagues, I demand vpon what course and how many leagues the other ship shall sayle, to bring himselfe 50. leagues *S. b. W.* from the first ship?

A. The first ship hath sayled *S. e. b. e.* and hath raised the pole 5. degrees, the second ship must sayle northeast by north 217. leagues.

## The Seamans Secrets.



Although it may seeme ( to some that are very expert in Nauigation ) that these questions are needlesse, and without vse, being so plaine as not deservuing in this sort to be published, notwithstanding that their opinion, I doe in friendly curtesie aduise all young practisers of this excellent Art of Sayling, that they doe not onely by their Charts prooue the truth of these answered questions, but also indeuour themselves to propound diuers other sorts of questions, and in seeking their answeres, to enter into the reason thereof: for by such exercise, the yong beginner shall vnderstand the substantiall grounds of his Chart, and grow perfect therein: for whose ease and furtherance onely, I haue at this present published this brieue treatise of Nauigation, knowing that the expert Pylot is not vnfurnished of these principles, but euery little helpe doth greatly further in euery beginning: and therefore for the further benefit of the practiser, I haue hereunto annexed a particular Sea Chart of our Channell, commonly called the Sleue, by which all that is before spoken as touching the vse of the Chart, may be practised, wherein the depths of the Channell are truly layd downe: being an instrument most commodious and necessary for all such as seeke the Channell coming out of the Ocean Sea, much of it is from my owne practise, the rest from Pylots of very good sufficiency: I haue found great certaintie by the vse of this Chart, for by the altitude and depth I haue not at no time missed the true notice of my Ships being, which (through Gods mercifull favour) by my land falls I haue found alwayes to be without error, therefore haue it not in light regard, for it will giue you great euidence, and is  
worthy



## The Seamans Secrets.

worthy to be kept as a speciall iewel for the Seamans vse, be he neuer so expert.

And thus hauing sufficiently expressed all the practises appertaining to the skill of Horizontall Nauigation, which kinde of sayling is now of the greatest sort onely practised, I thinke it good for your better memory briefly to report that which before is spoken as touching this kinde of Nauigation, and with all it will not be amisse to shew you after what sort I haue been accustomed to keepe my accompts in my practises of sayling, which you shall finde to be very sure, plaine, and easie, whereby you may at all times examine what is past, and so reforme the causes layd downe vpon the Chart, if by chance there should any error be committed. And so concluding this part of Nauigation, will in the next treatise make knowne vnto you the vse of the Globe, such vses I meane as the Seaman may practise in his voyages, and that are most necessary for his knowledge.

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H 2

A Table

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## The Seamans Secrets.

**A** Table shewing the order how the Seaman may keepe his accompts, whereby he may at all times distinctly examine his former practises, for in euery 24. houres, which is from noone to noone, he doth not onely lay downe his latitude, with the corse and leagues, but also how the winde hath blowne in the same time.

The first Colume is the moneths and dayes of the same, the second is the obserued altitude, the third is the Horizontall corse or motion of the Ship, the fourth the number of leagues that the Ship hath sayled, the fifth is a space wherein must be noted, by what winde those things haue beene performed: and the next great space is to lay downe any brieue discourse for your memory.

Moneths and dayes of the moneth.		Anno. 1593.				
		Latitude. G. M.	Corse.	Leages	Winde.	
March.	24	7   30	N.N.E.	25	East	The 23. of March, cape S. Augustine in Brafill being sixteen leags East from me, I began this accōpt.
	25	5   44	N.b.E. nor.	36	E.b.N.	
	26	4   1	N.b.N.	35	E.b.N.	
	27	2   49	N.	24	E.b.N.	
	28	1   31	N. easterly.	26	E.b.N.	
	29	1   4	N.N.W.	9	N.E.	
Aprill.	31	0   0	N.b.W.	21	E.N.E.	Compass varied 9 d. the South point west- ward. Compass varied 8 d. the South point west- ward. Compass varied 6 d. 40 m. the South point westward. Observation, the Pole arctick above the Hori- zon Compass varied 7 d. the North point east- wards.
	4	0   39	N.W.b.N.	15	N.E.	
	7	1   53	N.N.W.	28	N.E.	
	9	3   5	N.W.b.N.	30	N.e.b.e.	
	10	4   5	N.W.b.N.	22	N.e.	
	11	4   45	N.W.	18	N.e.b.N.	
	12	5   16	N.W.	14	N.e.b.N.	
	13	6   11	N.W.b.N.	23	N.e.	
	14	7   16	N.W.b.N.	24	N.e.	

A brieue



## The Seamans Secrets.

A bricfe repetition of that which is before spoken.

**T**here are three kindes of Navigation. Horizontall, Paradorall, and sayling vpon a great Circle, performed by Cozle and Trauers.

A Cozle is the paradorall line, which is described by the ships motion vpon any point of the Compasse.

A Trauers is the varietie of the ships motion vpon euery alteration of Cozles.

The Compasse is an artificiall Horizon, by which Cozles and Trauerses are directed, and containeth 12. points, and euery point containeth  $11\frac{1}{4}$ . degrees, or 45. minutes, being  $\frac{1}{4}$  of an houre.

By such quantitie of time as the Moone seperateth her selfe from the Sunne, by the like rate of time euery tyde doth one differ from another.

In euery houre the tyde altereth two minutes, in euery floud twelue minutes, and in euery ebbe twelue minutes, and in euery day 48. minutes, because that so is the Moones seperation from the Sunne: for the Moone doth seperate her selfe from the Sunne, in euery day one point and 3. minutes, betwene the change and the full shee is to the Eastwards of the Sunne, and then is her seperation, at which time shee is before the Sunne in respect of her naturall motion, but in regard of her violent motion, shee is then behinde or abaft the Sunne.

Betwene the full and change, shee is to the westward of the Sunne, applying towards the Sunne, and then is her application, at which time shee is behinde or abaft the Sunne, in respect of her naturall motion, but in consideration of her violent motion, shee is then before the Sunne.

She hath a violent motion, a naturall motion, a slow swift and meane motion.

In euery 27. dayes and 8. houres shee performeth her naturall motion through the Zodiac.

Betwene change and change there is twentie nine dayes twelue houres, fortie foure minutes nearest.

The solar yere consisteth of 12. moneths, and the lunar yere of 12. Moones.

## The Seamans Secrets.

The Moones age is found by the Epact.

All instruments used in Navigation, of what shape or forme soever they be, are described or demonstrated upon a Circle, or some portion of a Circle, and therefore are of the nature of a Circle.

A degree is the 360. part of a Circle, how bigge or little soever the Circle be.

A degree is applyed after the 6. severall sorts, to the Equator, to the Meridian, to the Horizon, to the verticall Circle, to measure, to time.

Altitude is the distance, height, or mounting of one thing above another.

The Poles altitude is the distance betweene the Pole and the Horizon, or the portion of the Meridian which is contained betweene the Pole and the Horizon.

The altitude of the Sunne above the Horizon, is that portion of the verticall circle, which is contained betweene the Horizon and the Sunne.

Latitude, is that arke of the Meridian which is contained betweene the parallel of any place and the Equator, or that part of the Meridian which is included betweene the Zenith and the Equinoctiall.

Longitude, is that portion of the Equator contained betweene the Meridian of S. Michaels, one of the Isles of the Azores, and the Meridian of the place whose longitude is desired: the reason why the accompt of longitude doth begin at this Ile, is because that there the Compasse hath no varietie, for the Meridian of this Ile passeth by the poles of the world, and the poles of the Magnet, being a Meridian proper to both poles.

The longitude betweene place and place, is the portion of the Equator, which is contained betweene the Meridian of the same places.

Declination is the distance of the Sunne, Moone, & Starres, from the Equinoctiall, or that part of the Meridian which passeth by the Center of any celestiall body, and is contained betweene the same center and the Equinoctiall.

Hydrography is the description of the Ocean Sea, with all Isles, bancks, rocks and sands therein contained, whose limits



## The Seamans Secrets.

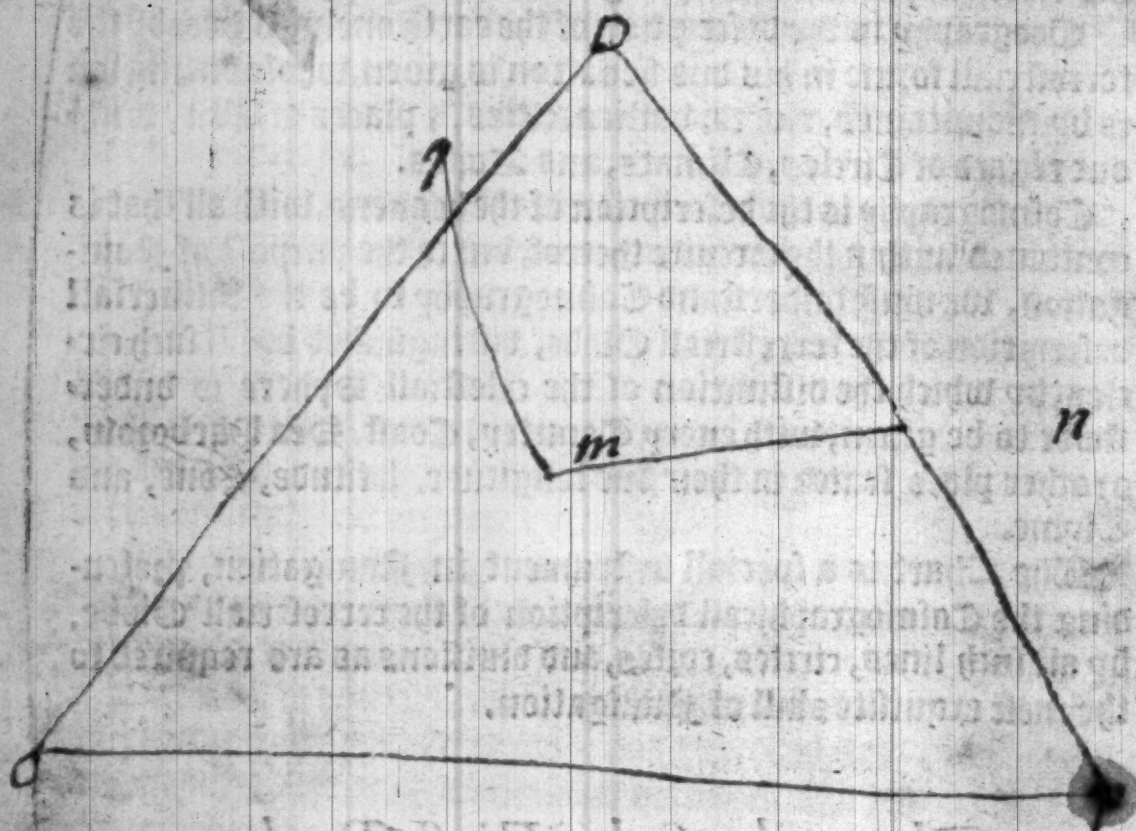
extend to the geographicall borders of the earth, the perfect notice whereof is the chiefeſt thing required in a ſufficient pylot, in his excellent practice of Sayling.

Geography is the deſcription of the earth onely, whereby the terreſtriall forme in his due ſituation is given, whoſe diſtinction is by mountaines, rivers, vallies, cities, & places of ſame, without regard of Circles, Climate, and Zones.

Cosmography is the deſcription of the heavens, with all that is contained within the circuite thereof, but to the purpoſe of Navigation, we muſt underſtand Cosmography to be the uniuerſall deſcription of the terreſtriall Globe, diſtinguiſhed by all ſuch circles, by which the diſtinction of the celeftiall Sphere is underſtoode to be given, with every Country, Coaſt, Sea Harbouro, or other place ſeated in their due longitude, latitude, Zone, and Clyme.

The Chart is a ſpeciall inſtrument in Navigation, pretending the Cosmographicall deſcription of the terreſtriall Globe, by all ſuch lines, circles, coſes, and diuiſions as are required to the moſt exquisite ſkill of Navigation.

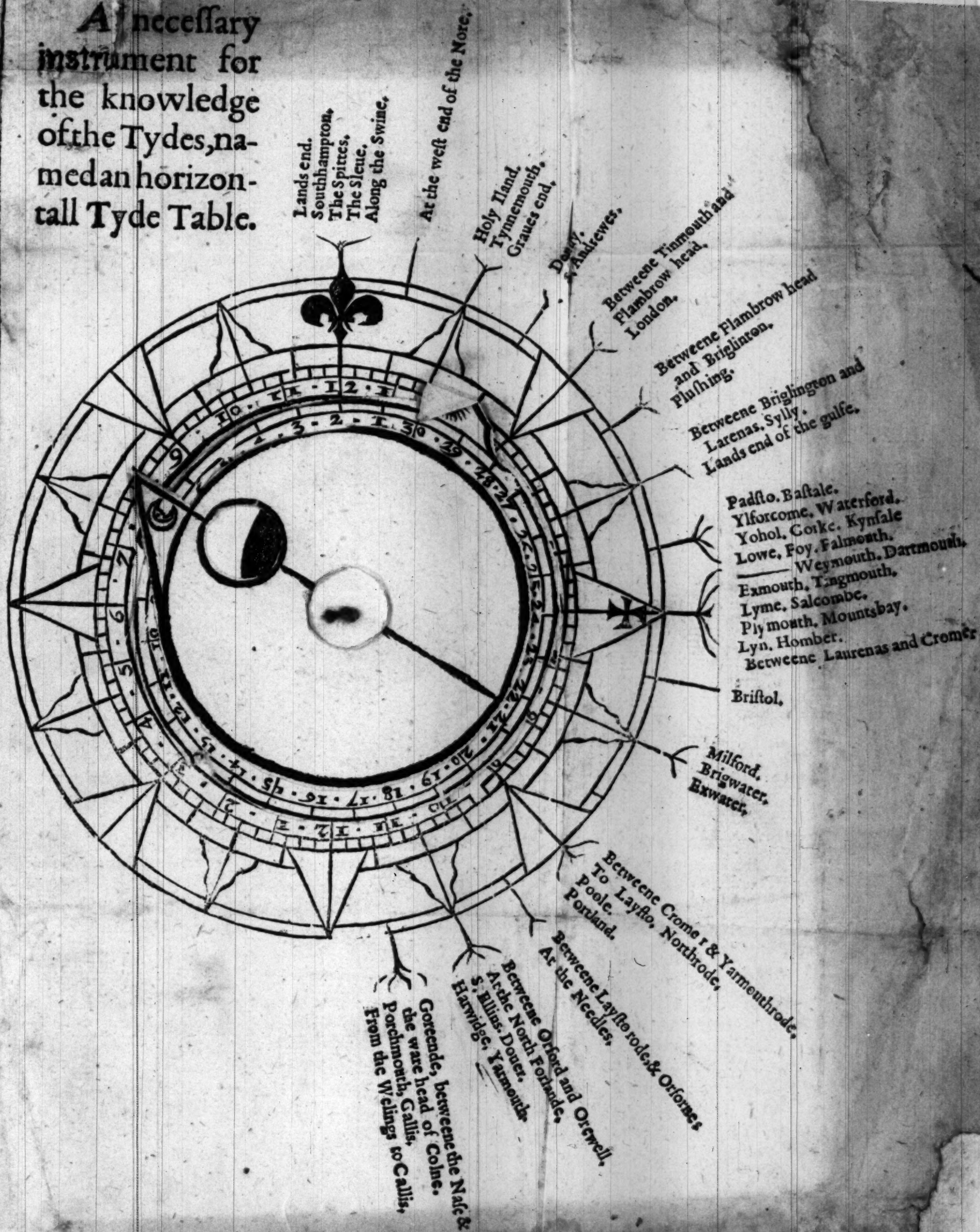
*The end of the Firſt Booke.*



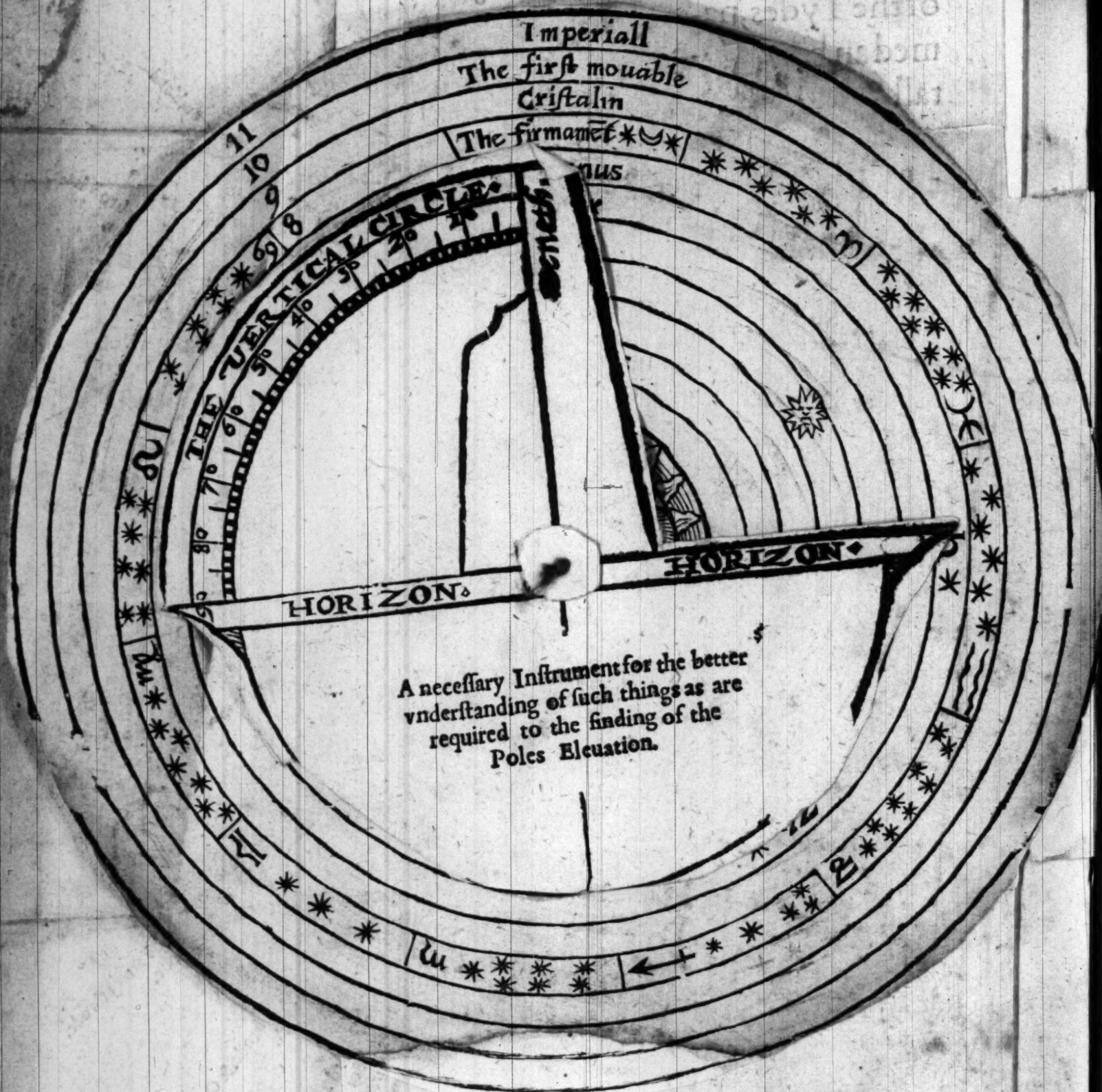
The end of the Fifth Book.



A necessary  
instrument for  
the knowledge  
of the Tydes, na-  
med an horizon-  
tall Tyde Table.







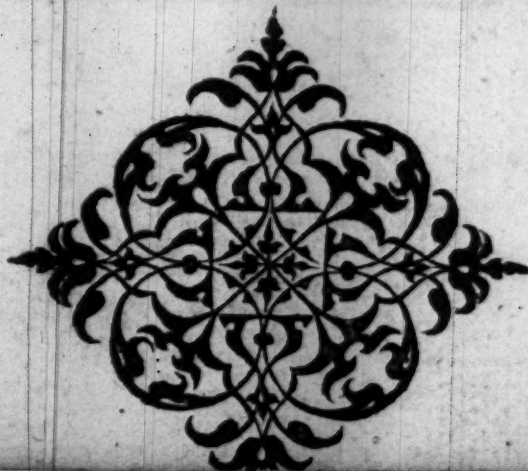




THE  
SECOND PART  
OF THIS TREATISE  
OF NAVIGATION.

VVHEREIN IS TAUGHT  
the nature and most necessary vse of the  
Globe, with the Circles, Zones, Climates,  
and other distinctions, to the perfect vse  
of SAYLING.

*By which most excellent Instrument is performed all that is needfully required to the full perfection of all the three kindes of Navigation.*









THE  
SECOND BOOKE OF  
THE SEAMANS SECRETS.

What is the Sphere?



The Sphere is a solide body contained vnder one superficies, in the midst whereof there is a point or prick, which is the center of the Sphere, from whence all right lines drawne to the circumference, are equall the one to the other, whereby it is to be vnderstood, that the center of the Sphere is evenly placed in his midst, as that it hath like distance from all parts of the Circumference. And soz as much as the Sphere is an Instrument demonstrating vnto vs the vniuersall ingine of the world, we must therefore vnderstand this center to be this terrestriall Globe wherein we haue our being, which compared to the celestiall Globe or heauenly circumference doth beare proportion, as the center to his circle: which earthly globe by the diuine mighty workmanship of God, doth admirably hang vpon his center, being of equall distance from all parts of the Circumference.

What are the distinctions of the Sphere?

The Sphere is distinguished by the ten circles, whereof 6. are great circles, and 4. are lesse circles: whereof there are onely 8. described vpon the body of the globe, limiting the zones and motion of the Planets, as the Equinoctiall, the Ecliptick, the Equinoctiall Colure, the Solsticiall Colure, the Tropick of Cancer, the Tropick of Capricorne, the Arcticke Polar Circle, & the

## The Seamans Secrets.

Antartick Polar Circle. The Horizon and Meridian are not described upon the body of the globe, but artificially annexed thereunto for the better perfection of his vse.

Which are the great Circles, and which the lesser?

**T**he Equator, the Ecliptick, the 2. Colures, the Meridian and the Horizon, are great circles, because they deuide the sphere into 2. equall parts. The 2. Tropickes, the Polar circles, are lesser circles, because they deuide the Sphere into two vnequal parts.

Which is the Equator or Equinoctiall?

**T**he Equinoctiall is a great circle deuiding the Sphere into two equall parts, leauing the one halfe towards the North, and the other halfe towards the South, and is equally distant from both the Poles of the world 90. degrees, placed evenly betwene them, and described upon them, this line crosseth the Horizon in the true points of East and West, and hath alwayes his one halfe aboue the Horizon, vnlesse it be vnder either of the Poles, for there the Equator is in the Horizon: it crosseth the Meridian at right Spherick angles, and it also crosseth the Ecliptick line in the first minute of Aries and Libra, deuiding the Ecliptick and Horizon, and is also by them deuided into two equall parts. This line is also deuided into 360. equall parts or degrees, which are the degrees of Longitude, beginning the account in the point of Aries, reckoning towards the East, concluding the number 360. in the place where the first account began: viz. where the Equator doth interseate the Ecliptick in the first minute of Aries, vnder which Meridian S. Mihels one of the yls of the Aflores to be placed in the geographickall description of the terrestriall Globe.

What is the vse of the Equator?

**T**he vse of the Equinoctiall, is to know the declination of the Sunne, Moone, and Starres, whereby the latitude of places is giuen, for that portion of the Meridian which is contained betwene the Equator and the Center of the Sunne, Moone, or Starres, is their declination: also by the Equinoctiall is knowne  
the



## The Seamans Secrets.

the Longitude of places, for a quarter of a great Circle being drawne from the Pole, to the place whose Longitude is desired, and so continued to the Equinoctiall, that degree and minute in which the quarter Circle doth touch the Equator, is the Longitude of the same place, or if you bring any place (that is described vpon the Globe) whose Longitude you would know, vnder the Meridian of the Globe, that degree of the Equinoctiall that is then likewise directed vnder the Meridian, is the Longitude desired: When the Sunne commeth vpon the Equator, then the dayes & nights are of one length throughout the whole world, and then the Sunne riseth vpon the true point of East, and setteth vpon the true point of West, and not els at any time. This circle being fixed in the firmament is moued with the first mouer in euery houre 15. degrees, by which accompt in 24. houres his motion is performed. And here note, that the degrees of the Equinoctiall haue a double application, the one to time, and the other to measure: in respect of time 15. degrees make an houre, so that euery degree containeth but 4. minutes of time, but when his degrees haue relation to measure, then euery degree containeth 60. minutes, being 20. leagues, of that euery minute standeth for a mile after our English accompt.

But this allowance of 20. leagues to euery degree of the Equinoctiall, in sayling, or measuring of distances vpon the East & West Cozses, is onely when you are vnder the same, because the Equinoctiall being a parallell, is likewise a great circle, and euery degree of a great circle is truly accompted for 20. leagues or 60. miles.

But in the rest of the parallells where either of the Poles are eleuated aboue the Horizon, if there you sayle or measure vpon the Cozses of east or west, there are not 20. leagues to be allowed to euery degree, because such parallells are lesser Circles, therfore they haue the fewer number of leagues to euery degree: so that the further you depart from the Equator, the lesser are the parallells, and the lesser that any parallell is, the lesser are his degrees, because euery circle containeth 360. degrees, and as the circles and degrees are diminished in their quantitie, in like sort the distance answerable to such degrees, must abate, as their circles doe decrease. And further know, that the Equator, is the

## The Seamans Secrets.

beginning of all terrestriall Latitude, and declination of the celestiall bodies.

What is the Ecliptick?

**T**he Ecliptick line is a great circle, deviding the Sphere into two equall parts, by crossing the Equator in oblique sort deviding him, and being devided by him into two equall parts, bending from the Equator towarde the North and South 23. degrees, and 28. minutes, being in the first minute of Cancer and Capricorne, there determining the Tropical limits, this line likewise devideth the Zodiac, by longitude into 2. equall parts, and is devided together with the Zodiac, into 12. equall portions called signes, and euery of these signes is devided vpon the Ecliptick into 30. equall parts or degrees, so that this line is devided into 360. degrees, vpon which line the center of the Sunne doth continually mooue: this circle is described vpon his proper poles, named the Pole of the Zodiac, being in all his parts 90. degrees from either of them.

The Zodiac is a circle contrary to all the other, for they are Mathematicall lines, consisting onely of length, without breadth or thickenesse: but the Zodiac hath latitude or breadth 12. degrees, whose limits are 6. degrees of either side of the Ecliptick, wherein the Sunne, Moone and Planets performe their motions and revolutions, the center of the Sunne onely keeping vpon the Ecliptick, but the other Planets haue sometime North latitude, and sometime South latitude. And here you must vnderstand, that the latitude of the Planets or Starres, is that portion of the Eclipticall Meridian which is contained betwene the center of the Planet or Starre, and the Ecliptick line, and their longitude is that portion of the line Ecliptick, which is contained betwene the said Meridian and the Eclipticall Meridian that passeth by the poles of the Zodiac and the first minute of Aries.

The 12. deuisions or signes of the Zodiac, are these, Aries ♈, Taurus ♉, Gemini ♊, Cancer ♋, Leo ♌, Virgo ♍, Libra ♎, Scorpio ♏, Sagittari ♐, Capricorne ♑, Aquarius ♒, Pisces ♓: and these are their Characters that stand by them.

The 7. planets that keepe within the limit of the Zodiac, are these: Saturne ♄, Iupiter ♃, Mars ♂, Sol ☉, Venus ♀, Mercury ☿, Luna ☾, Saturne performes his course through all the degrees of the



## The Seamans Secrets.

the Zodiac, once in euery 30. yeares : Iupiter in 12. yeares: Mars in 2. yeares, the Sunne in 365. dayes and 6. houres being one yeare, Venus and ♀, as the Sunne, and the Moone performeth her course in 29. dayes and about 8. houres, thzough all the degrees of the Zodiac.

And note that this naturall motion of the Planets in the Zodiac, is from the West toward the East, the diurnall motion is violent, caused by the first mouer, or primum mobile, who in euery 24. houres doth performe his circular motion from the East to the West, carrying with him all other inferiour bodies whatsoener.

What is the vse of the Zodiac ?

**B**y the Zodiac and Ecliptick is knowne the Longitude and Latitude of any Celestiall body, either Planets or fixed Starres, for a quarter of a great circle drawne from the pole of the Zodiac to the center of any Planet or Starre, and so continued untill it touch the Ecliptick, that degree and minute where the said quarter circle toucheth the Ecliptick, is the longitude of the said body, which is to be accompted from the first minute of Aries, for the longitude of Aries is the portion of the Ecliptick line, which is contained betwene the eclipticall meridian passing by the poles of the Zodiac, and the first minute of Aries, and the eclipticall meridian which passeth by the poles of the Zodiac and the center of any Planet or Starre.

When the Planets are vpon the Northside of the Ecliptick, they haue North latitude, and being South from the Ecliptick, they haue South latitude.

Also the motions of the Planets, the time of any Eclipse, and the Sunnes declination by his place in the Ecliptick, are known by this circle, whose vse is very ample and to great purpose for all Astronomicall considerations.

What are the Colures ?

**T**he Solstitiall Colure is a great circle passing by the poles of the world, and the poles of the Zodiac and the Solstitiall points or first minute of ♋, and ♑, cutting the Equinoctiall at right Anglerick angles, in his 90. and in his 270. degrees.

## The Seamans Secrets.

The Equinoctiall Colure is likewise a great circle passing by the poles of the world, and the equinoctiall point of  $\gamma$ , and  $\omega$ , and crosseth the equator in his first & 18. degrees, and these Colures do intersect each other in the poles of the world to the right Spherick angles.

What is the vse of these Colures?

Their vse is to distinguish the foure principall seasons of the yeare, Spring, Summer, Autumne, and Winter, deviding the Equator and Ecliptick into 4. equall parts: also that Arke of the Solsticiall Colure which is included between the first minute of  $\odot$ , and the Equinoctiall, is the Sunnes greatest declination toward the North, the like Arke being between the tropicall point of  $\psi$ , and the Equator, is the Sunnes greatest South declination, being in these our dayes 23. degrees, 28. minutes.

What is the Tropick of Cancer?

The Tropick of  $\odot$  is one of the lesser Circles deviding the Sphere into two vnequall parts, and is described vpon the pole Artick, a parallell to the Equator. 23. degrees 28. minutes from him, being the farthest limit of the Ecliptick bending towards the North, to which when the Sunne cometh, the dayes are then longest to all those that inhabite in the North parts of the world, and shortest to the Southerne inhabitants: betwene this circle & the equator are included the 6. septentrionall signes,  $\gamma$ ,  $\delta$ ,  $\epsilon$ ,  $\zeta$ ,  $\eta$ ,  $\theta$ , in which signes during the time that the Sun abideth, being from the 11. of March, to the 13. of September, he hath North declination, and then is the spring and Summer to all such as inhabite in the North parts of the world: and Autumne and Winter to the Inhabitants of the South parts of the world: this circle doth touch the Ecliptick in the first minute, of  $\odot$ , where the Sunne beginneth his returne toward the South, whereupon it tooke the name Tropick, which signifieth conuersion or returne, by which point of the Ecliptick, the diurnall motion describeth this Circle.

What



## The Seamans Secrets.

What is the Tropick of Capricorne?

**T**he Tropick of  $\psi$ , is one of the lesser Circles deviding the Sphere into two unequal parts, and is described upon the pole Antartick a parallell to the Equinoctiall 23. degrees, 28 minutes from him, being the farthest bending of the Ecliptick towards the South, to which when the Sunne commeth, the daies are then longest to all those that inhabite in the South parts of the world, and shortest to the Northern Inhabitants: betwene this circle and the Equator are included the 6. Southern signes,  $\pi$ ,  $m$ ,  $f$ ,  $\psi$ ,  $\alpha$ ,  $\chi$ , in which signes during the time that the Sun abideth, being from the 13. of September to the 11. of March, he hath South declination, and then is the spring and the Summer to all such as inhabite the South parts of the world: and Autumne and Winter to all the inhabitants in the North parts of the world: this circle toucheth the Ecliptick in the first minute of  $\psi$ , by which point the diurnall motion describeth this parallell.

What is the vse of the Tropicks?

**B**y the Tropicks the Sunnes declination is knowne, as also the tropickes by the Sunnes farthest motion towards the North and South, for so much as the Tropicks are distant from the Equator, so much is the Sunnes greatest declination: and such as is the Sunnes greatest declining, such is the distance betwene the Tropicks & the Equator: they are also the limits of the burning zone, seperating the burning and temperat zones. For betwene the two Tropicks, is contained the burning zone.

What is the Artick polar Circle?

**T**he artick Polar Circle is one of the lesser Circles, deviding the sphere into two unequal partes, and described upon the pole Articke in parallell, to the Tropick of  $\delta$ , having such distance from the pole as the Tropick hath from the Equator, being 23. degrees 28. minutes; upon which circle the Artick pole of the Zodiac is placed, which being fixed in the firmament, by the vertue of the first mover is carried about with the heavens, by which motion this circle is described.

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What is the Antartick polar circle?

**T**he Antarticke polar circle is opposit to the Artick, and parallel to the Tropick of  $\gamma$ , being in all respect of such distance and description, from and about the pole Antartick, as the Artick polar circle is about the pole Artick.

What is the vse of Artick and Antartick polar circles?

**T**he vse of these two polar Circles, is to shew the distance of the poles of the Zodiac, from the poles of the World, for so much as the Sollicitall points are distant from the Equator, so much are the poles of the Zodiac from the poles of the World: the Circles doe also deuide and limite the temperate and frozen zones, for betwene the Tropick of  $\gamma$ , and the Artick polar Circle is contained the Northern temperate zone, and betwene the Artick polar Circle & the pole Artick, that is within the Artick polar circle is contained the Northern frozen zone. Also betwene the Tropick of  $\gamma$ , and the Antartick polar Circle, is contained the Southern temperate zone, and within the said polar Circle, is included the Antartick frozen zone, and these are all the Circles that are described vpon the body of the Globe.

What is the Meridian?

**T**he Meridian is a great Circle passing by the poles of the World, and by your Zenith, deuiding the horizon into two equall parts, in the points North and South, it also deuideth the Sphere with all the parallel Circles therein contained, into 2. equall parts, crossing them at right Spherick angles. And this Meridian is not fixed in the firmament as the rest of the Circles are, for if it were, then should it be moued with the first moouer as the rest are, but it is not so: therefore the Meridian is manifested vpon the Globe by a circle or ring of copper fastned by to the Globe, vpon the 2. poles, so that the Globe moueth round vpon his 2. poles within the Meridian: this Meridian is graduated in euery of his quarters into 90. degrees, by which his vse is performed: and note that one Meridian may haue many Horizons, yet euery Horizon hath but one Meridian, for if you tra-



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uaile South or North, you keepe still vpon the same Meridian, yet in euery sensible difference of distance you shall enter into a change of horizons, for there be, as many Horizons as there be sensible differences of distance, and there be as many Meridians as there be sensible differences of distance, so that the difference be not vpon the paynts North and South, but this copper Meridian annexed to the Globe is to be applied to all differences and distances whatsoeuer, as amply as if the number were infinite.

What is the vse of the Meridian?

**T**he vse of the Meridian is to knowe the highest ascending of the Sunne, Moone or Starres from the horizon, for when they be vpon the Meridian, then are they farthest from the Horizon, and then is the most conuenient time to take the altitude in the Sunne or Starres, thereby to finde the poles eleuation.

The Meridian of your Globe is knowne the latitude and longitude of any place vpon the Globe contained, for if you bring any place vnder the Meridian, the degrees of the Meridian doe shew the latitude of the same, and that degree of the Equator which the Meridian doth crosse is the longitude.

What is the Horizon?

**T**he Horizon is a great circle deuiding the heavens into two equall parts, the one halfe being aboue the horizon is alwayes in sight, the other halfe is not seene being vnder the Horizon, and therefore is called the finitor or limit of our sight, for where the heavens and seas seeme to ioyne together, that is the Horizon: the Horizon is not fixed in the firmament, and yet is a fixed circle constant to his proper latitude, but because in the Globe one and the same Horizon may performe whatsoeuer is required to all eleuations, the Horizon is so artificially annexed to the Globe, that by the motion of the Meridian, in the same there faulteth nothing in his vse: and the Horizons in all respects distinguished, as in the Sea Compass. There are two kindes of Horizons, a right horizon, and an oblique horizon: when the Poles are in the horizon, then it is a right horizon, for then the

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Equatoz doth cut the Horizon to right angles, making a right Sphere and a right Horizon, an oblique horizon are where either of the Poles are elevated above the same, so; then the equatoz doth cut the Horizon to unlike angles, making an oblique Sphere, and an oblique Horizon, and although the horizons be diuers and many in number, for every sensible difference of distance hath his proper Horizon, yet is the horizon of the Globe so conveniently annexed thereunto, as that by the moving of the Meridian in the horizon, and by the Globes motion in the Meridian, both the horizon and Meridian are to be applyed as proper to all places whatsoeuer, and note that the place where you are, is alwayes the center of the plaine superficiall horizon.

What is the vse of the Horizon?

The Horizon is the beginning of all altitude, for whatsoeuer is above the horizon, is sayd to haue altitude moze, and by the horizon such altitudes are giuen with helpe of the Crosse staffe, for placing the Crosse staffe at your eye, if by the one end of the transuersary you see the horizon, and by the other end (at the same instant) you see the body obserued, then doth the transuersary shew vpon the staffe the altitude desired, by the horizon the navigable courses from place to place are likewise knowne, as also the quantitie of the rising and setting of the Sunne, Moone, and Starres: whereby is knowne the length of the dayes and nights in all climates and at all seasons: by the horizon is knowne vpon what degree of Azimuth, the Sunne, Moone, or Starres are, when they may be scene, in what part of the heauen soeuer, whereby the variation of the Compasse is found, and the Poles altitude may at all seasons be giuen.

Are these all the circles appertaining to the Globe?

There are other circles which are fixed and doe properly appertain to every particular horizon, as Azimuths, Almucanters, the Articke, and Antartick Circles.

What are circles of Azimuth?

Circles of Azimuths, or verticall circles, are quarters of great circles, concurring together in the Zenith, as the Meri-



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dians doe in the pole, and are extended from the Zenith to euery degree of the horizon, &c. And because they cannot be conueniently described vpon the Globe to be applyed to all horizons, therefore vpon the Meridian of the Globe there is a piece of copper artificially placed, to be removed to any degree of the Meridian at pleasure, which piece of copper representeth the Zenith, and must alway be placed so many degrees from the Equator, as the pole is eleuated from the horizon, and vnto this Zenith there is ioyned a quarter of a great Circle called *Quarta altitudo*, the ende whereof doth continually touch the horizon, and is so ioyned to the Zenith, as that it may be mooued round vpon the horizon, and to euery part thereof at your pleasure: this *Quarta altitudo* is deuided into 90. degrees, being the distinction of all altitude, and beginneth the account from the horizon, which is the beginning of altitude, and concludeth 90. degrees in the Zenith, being the end and extreame limit of all altitude.

What are Almicanter?

**A**lmicanter or Circles of altitude, are parallell circles to the horizon, & are described vpon the Zenith, as the parallels to the Equator, are described vpon the Poles, of which circles there are 90. answerable to the distinctions of the *Quarta altitudo*, which are the degrees contained betweene the horizon and Zenith, these circles cannot be described vpon the Globe, to be applyed to euery horizon, but they are distinguished by the circular motion of the *Quarta altitudo*, for if I desire to see the Almicanter circle of 10. degrees, by moouing the *Quarta altitudo* round about the horizon, the Zenith degree of their quarter circle, doth shew the Almicanter desired, in what eleuation soeuer.

What is the vse of these two circles?

**T**he *Quarta altitudo* performeth the vse of both, by the *Quarta altitudo* and horizon the courses from place to place are knowne, according to the true horizontall position, as hereafter shall plainly appeare: it also sheweth the degree of Azimuth, and obserued altitude of any celestiall body, in what latitude soeuer: by the *Quarta altitudo* and Horizon, you may describe a

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paradorall Compasse vpon the Globe, the Poles height is at all times thereby to be knowne, and the variation of the Compasse is thereby likewise giuen, as hereafter in the practise you shall be taught.

What are the Artick and Antartick circles?

**E**very horizon hath his proper Artick or Antartick circle, those horizons that haue the pole Artick eleuated aboue them, haue their proper Artick circle, and those that haue the South pole eleuated, haue their proper Antartick circle, the quantitie of which circle is according to the Poles eleuation, for if the pole be much eleuated, then is the Artick circle great, for the poles altitude is the semidiameter of this circle, if the pole be in the Zenith, then halfe the heauens is the Artick circle.

What is the vse of this circle?

**I**f the Sunne, Moone, or any Starres be within this Circle, they are neuer carried vnder the horizon during the time of their abode therein, whereupon it commeth to passe, that such as trauaile far towarde the North, haue the Sunne in continuall view, and those that inhabite vnder the pole (if any so doe) the Sunne is in continuall sight for sixe moneths together, because the sixe Septentrionall signes are within the Artick circle, the Equator being in the horizon &c.

There is another small circle, which is called Circulus horarius, or the houre circle, to be annered to the Meridian of the Globe, for the perfection of his vse, this circle must be deuised into 24. equall parts or houres, and those againe into such parts as you please for the better distinction of time: this circle must be fastened to the Meridian, so that the houres 12. must stand directly vpon the edge of the Meridian, and the Pole must be the center of this circle, vpon which pole there must be fastened an Index to moue proportionably, as the Sphere (vpon any occasion) shall be moued.

There is also an halfe circle, called the Circle of position, which alth it serueth to no great purpose for Navigation, I here omit, and thus is the Globe fully finished for the perfection of this vse.

What are the Poles of the world?

**T**here are two Poles, the North articke Pole, and the South or Antartick Pole, which poles are two immouable prickes



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fixed in the firmament, whereupon the Sphere is moved by vertue of the first mouer, and are the limits of the Axis of the world, as also the extreame terme or band of all declination, being 90. degrees from all parts of the Equator.

By the rayling of the Pole from the horizon, is knowne the parallell or latitude of our being, it also giueth the quantitie of the Artick circle, and obliquitie of the Sphere.

What is the Axis of the world?

**T**he Axis of the world is a right line passing by the center of the Sphere, and limited in the Circumference, about the which the Sphere moueth, and is therefore called the Axis of the Sphere, and as all lines comensurable are limited betweene two poynnts or prickes, so is the Axis of the world, and those two limiting prickes are called the Poles of the world.

What are the Poles of the Zodiac?

**T**he Zodiac hath likewise two Poles, Articke and Antarticke, being two prickes fixed in the firmament, limiting the Axis of the Zodiac, and are distant from the poles of the world 23. degrees, 28. minuts, which poles by the motion of the Sphere do describe the Poles circles, performing their motion about the poles of the world in euery 24. houres, by vertue of the first mouer, vpon these poles the Eliptick and Zodiac is described: also a quarter of a great circle graduated into 90. degrees, being fastened to eyther of these Poles and brought to the center of the Starre, sheweth by that graduation the latitude of the same Starre, and where the quarter circle toucheth the Eliptick, that is likewise his longitude, also the 7. Planets doe performe their naturall revolutions vpon these poles, whose motion is from the West towards the East, contrary to the motion of the first mouer.

What is the Axis of the Zodiac?

**T**he Axis of the Zodiac, is a right line passing by the center of the Sphere, and limited in the circumference, whose limiting poynnts are the poles of the Zodiac, and his Axis is moued by the Sphere as are his Poles.

What are the Poles of the Horizon?

**T**here are two Poles of the horizon, which are the limits of his perpendicular diuident, being equidistant 90. degrees from:

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from all parts of the horizon, and are the extreame limits of all altitude, that pole which is in the vpper hemisphere is called the Zenith, and his opposite Pole is called Nadir, they are extended in the firmament, but not fixed in it, for they moue neuer, but remaine alwayes stable to their proper horizon, which could not be if it were fixed in the firmament, for then should they be moued with the firmament as the rest are, by the helpe of these Poles is found the Azimuth and Almicanter of any celestiaall body, for a quarter circle deuided into 90. degrees, and fixed to the Zenith, as is the Quarta altitudo, being moued to any celestiaall body, doth by those degrees shew the almicanter or altitude of the same body from the horizon, and that part of the horizon which the quarter circle teacheth, is the azimuth of the same body, alwayes provided that the Zenith stand answerable to the poles eleuation, that is, so many degrees from the Equator, as the pole is from the horizon.





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How many Zones be there ?

**T**here are 5. Zones, two temperate zones, two frozen zones, and one burning zone, the burning zone lieth betwene two Tropickes, whose latitude is 46. degrees, 56. minutes, which zone by ancient Geographers is reported to be not habitable, by reason of the great heat which there they supposed to be, though the perpendicularitie of the Sunnes beames, whose perpetuall motion is within the sayd zone, but we finde in our travels, contrary to their report, that it is not onely habitable, but very populous, containing many famous and mighty nations, and yeldeth in great plenty the most purest things that by natures benefit the earth may procreate : twice I haue sayled through the zone, which I found in no sort to be offensive, but rather comfortable unto nature, the extremitie of whose heate is not furious but tollerable, whose greatestt force lasteth but 6. houres, that is, from 9. of the clocke in the morning, vnto 3. in the afternoone, the rest of the day and night is most pleasing and delightfull : therefore they did nature wrong in their rash report.

### Of the frozen Zones.

**T**he frozen Zones are contained within the polar circle, the Articke frozen zone within the Artick polar circle, and the Antarticke frozen zone within the Antartick polar circle, which are also reported not to be habitable, by reason of the great extremitie of colde, supposed to be in those parts, because of the Sunnes farre distance from those Zones, but in these our dayes wee finde by experience, that the ancient Geographers had not the due consideration of the nature of these zones, for three times I haue bene within the Artick frozen zone, where I haue found the ayre very temperate, yea and many times in calme weather marvellous hot : I haue felt the Sunnes beames of as forcible action within the frozen zone in calmes nere vnto the shore, as I haue at any time found within the burning zone : this zone is also inhabited with people of good stature, shape, and tractable

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conditions, with whom I have conuerſed, and not found them rudely barbarous, as I haue found the Caniballes which are in the Straights of Magilane, and Southerne parts of America : In the frozen zone I diſcouered a coaſt which I named Deſolation at the firſt view thereof, ſuppoſing it by the loathſome ſhape to be waſt & deſolate, but when I came to anchoꝝ within the harbours thereof, the people preſently came vnto me without feare, offering ſuch pooze things as they had to exchange foꝝ yꝝon nayles, and ſuch like : but the Caniballes of America ſie the preſence of men, ſhe wing themſelues in nothing to differ from bruit beaſts : thus by experience it is moſt manifeſt that thoſe zones which haue bene eſtimated deſolate and waſt, are habitable, inhabited and fruitfull. If any man be perſwaded to the contrary of this truth, he ſhall doe himſelfe wrong in hauing ſo baſe an imagination of the excellency of Gods creation, as to thinke that God creating the world foꝝ mans ble, and the ſame being deuided but into 5. parts, thꝛee of thoſe parts ſhould be to no purpoſe : but let this ſaying therefore of the pꝛophet Eſayas be your full ſatisfaction, to confirme that which by experience I haue truly ſpoken : *For thus ſayth the Lord that created heauen, God himſelfe that framed the earth and made it, he that prepared it, he created it not in vaine, he framed it to be inhabited, &c. Eſay 45. 18.*

### Of the temperate Zones.

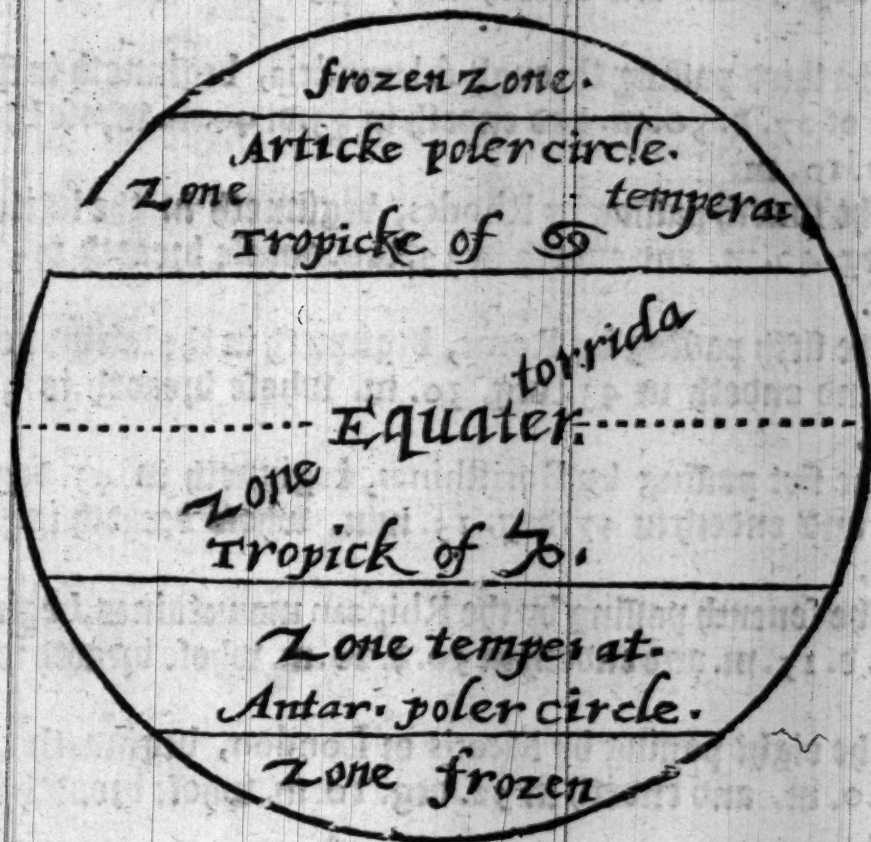
**T**he temperate Arctick zone is included betwene the Tropick of  $\odot$  and the Arctick polar circle, whole latitude oꝝ breadth is 42. degrees, 2. minutes, within the which we haue our habitation.

The temperate Antartick zone is limited by the Tropick of  $\gamma$ , and the Antartick polar circle, and hath breadth oꝝ latitude 42. degrees, 2. minutes.

What



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## What is a Climate?

**A** Climate is the space or difference upon the upper face of the earth, included between two parallels, wherein the day is sensibly lengthened or shortened halfe an houre, for as you tra-uaile from the Equator toward the Artick Pole, the Sunne ha-ving North declination, the dayes doe grow longer and longer, untill at last the Sunne not setting vnder the Horizon, you shall haue continuall day, and every space or distance that altereth the day halfe an houre, is called a Climate: these Climates take their names from such famous places as are within the said Cli-mates, of which there are nine, as by their distinctions may ap-peare.

1. The first passing through Meroe, beginneth in the latitude of 12. deg. 45. m. and endeth in 12. d. 30. m. whose breadth is 7. d. 45 m.

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2. The second passing through Syene, beginneth in the latitude of 20. deg. 30. m. and endeth in 27. d. 30. m. whose breadth is 7. d.
3. The third passing through Alexandria, beginneth in the latitude of 27. d. 30. m. and endeth in 33. d. 40. m. whose breadth is 6. d. 10. m.
4. The fourth passing by Rhodes, beginneth in the latitude of 33. deg. 40. m. and endeth in 35. deg. whose breadth is 5. deg. 20. m.
5. The fifth passing by Rome, beginneth in the latitude of 39. deg. and endeth in 43. deg. 30. m. whose breadth is 3. deg. 45. m.
6. The sixt passing by Boriskhines, beginneth in 43. deg. 39. min. and endeth in 47. deg. 15. min. whose breadth is 3. deg. 45. m.
7. The seventh passing by the Rhipaan mountaines, beginneth in 47. d. 15. m. and endeth in 50. d. 20. m. whose breadth is 3. d. 5. m.
8. The eight passing by Meotis or London, beginneth in 50. deg. 20. m. and endeth in 52. deg. 10. m. whose breadth is 2. d. 50. m.
9. The ninth passing by Denmarke, taketh his beginning in the latitude of 53. d. 10. m. and endeth in the latitude of 35. d. 30. m. and hath in breadth 2. d. 20. m.

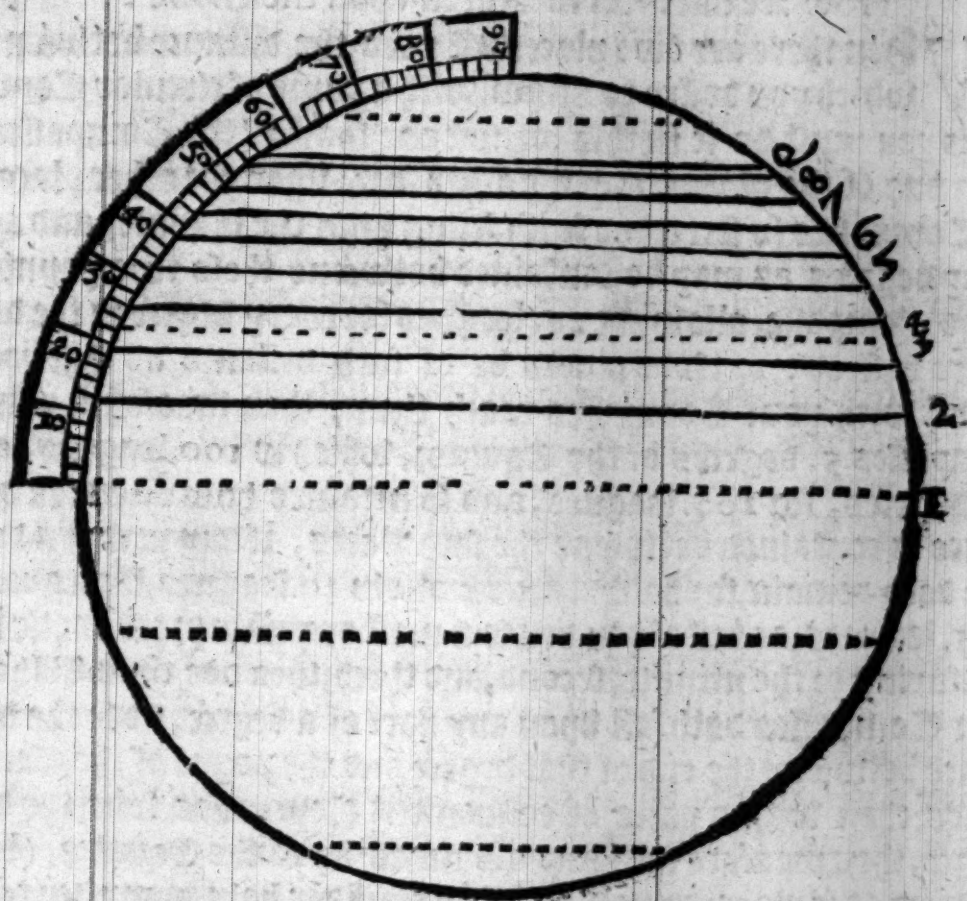
If you desire to know how many leagues every Climate is in breadth, allow for every degree 20. leagues, or 60. miles, and for every minute a myle, so is the distance given.

Thus haue I manifested vnto you all the diuisions and particularities of the Spheres distinction.

What.



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What is the vse of the Globe?

**T**he vse of the Globe is of so great ease, certaintie, and pleasure, as that the commendations thereof cannot sufficiently be expressed, for of all Instruments it is the most rare and excellent, whose conclusions are infallible, giving the true line, angle, and circular motion of any Course or Travers that may in Navigation happen, whereby the longitude and latitude is most precisely knowne, and the certaintie of distance very plainly manifested, according to the true nature thereof: it giueth the variation of the Compass, and the houre or time of the day at all seasons, and in all places. And by the Globe the poles height may at all instants and vpon euery point or Azimuth of the Horizon by the Sunnes altitude taken be most precisely knowne, by the certaintie of whose excellent vse, the skillfull Pilot shall receiue great content in his pleasing practise gubernautick.

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How are distances measured vpon the Globe ?

**W**hen there are two places assigned, the distance betwene which you desire to know, with a payre of circular Compasles you must do it in this sort: let one foote of the Compasles vpon one of the places, and the other foote vpon the other place, the Compasles so stretched forth, bring vnto the Equator, and as many degrees as may be contained betwene those two points of the Compasse, allowing 20. leagues for every degree is the distance desired: or if the places be of such distance as that you cannot with your Compasles reach them, then take with your Compasles 5. degrees of the Equator, which is 100. leagues, or 10. degrees, for 200. leagues, and so measure how often the distance is contained betwene the said places, if any part of a degree doth remain, for halfe a degree allow 10. leagues, for a quarter 5. leagues, &c. but if you desire a most exquisite precisenesse in measuring to the minute, second, and third, then doe thus. When your Compasles doth fall vpon any part of a degree, note the distance betwene the end of that degree and the point of the Compasles, then with a paire of conuenient Compasles take the distance, then measure the same 60. times vpon the Equator, (beginning at some certaine place) then consider how many degrees are contained within the measure, and allow every degree to be a minute or mile, so are the leagues and miles knowne, if any part of a degree remaine vpon this measure of minutes, doe as at the first, measuring the same 60. times vpon the Equator, the degrees comprehended within the measure, are seconds: if any parcell of a degree remaine vpon these seconds, do as in the first, and the degrees contained in this measure are thirds, and so you may proceede infinitely.

How may the Globe be rectified answerable to the true position, of the heauens for any place, or promontory.

**T**he place being knowne for which you would rectifie the Globe, doe thus: bring the place vnder the Meridian, & there consider the latitude thereof: and as many degrees as that place is from the Equator, so many degrees you must eleuate the pole from the Horizon, then bring the Zenith directly ouer the same place,



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place, and so is your Globe rectified for the execution of any practise: and without this ordering of the Globe, there is no conclusion to be executed by the same.

How is the longitude or latitude of places knowne by the Globe?

**B**y turning the Globe within the Meridian, you must bring the Promontory Bay, Harbouro, Cittie, or other place (whose latitude and longitude you seeke) precisely under the Meridian, there holding the Globe steady, the degree of the Meridian that is directly over the said place, sheweth the latitude thereof, and that degree of the Equinoctiall which is directly under the Meridian is the longitude of the same place.

How is the Course found betweene place and place?

**T**wo places being assigned, the Course between which you desire to know, first seeke the latitude of one of these places, and rectifie the Globe answerable unto the same, as before is taught, then bring that place directly under the Meridian and Zenith, if both places be under your Meridian, they then lie North and South, if not, then bring the Quarta altitudo to the other place, and note upon what part of the Horizon the end of the same toucheth, for that is the precise Horizontall Course betweene the said places, but this you must consider, that the Horizontall Course is not the navigable Course, unless the places be of small distance, for if any place beare Northeast from me, or East from me, or upon any other point, North or South excepted, and be distant 500. leagues, if I sayle upon the Horizontall Course, I shall neuer arrive unto the same place.

How then shall the Pilote sayle by the Globe, if the matter be so doubtfull?

**T**he skillfull Pilote that useth this excellent instrument, doth first consider the place from whence he shapeth his Course, and rectifieth the Globe answerable to the same, then bringing the

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the place directly vnder the Meridian and Zenith, there holding the Globe steady, bringeth the Quarta altitudo to the place for which he is bound, the end whereof sheweth vpon the Horizon the true Horizontall Course, vpon which Course he sayleth 20. or 30. leagues, and there maketh a note or picke by the edge of his Quarta altitudo, according to the true distance proued by Course, reckoning an altitude as in the vse of a Chart: then he bringeth that picke or note vnder the Meridian, and there considereth the true latitude of his being, he then rectifieth the Globe answerable to the same picke, and keeping the same vnder the Zenith, doth againe turne to the Quarta altitudo to the place for which he is bound, the end whereof sheweth vpon the Horizon the Horizontall Course, then sayling as at the first, he maketh a note or picke as before, and thus prosecuting his Course, shall arrive vnto his desired place: but in this practise he shall plainly proue that his Horizontall Course will differ greatly, and that by his sayling in this sort he shall by his notes and pickes describe the true nautigable and nearest Courses betwene the said places: The like methode is to be obserued vpon any trauers or forced course whatsoever: and therefore the Pilote must take care, that although the wind be neuer so favourable, yet he must not prosecute any Horizontall Course (North and South onely excepted.)

Therefore I say the Pilote must take speciall care to consider the distance of places, whether the Horizontall Course will lead him betwene the said places, for if places be more then 45. degrees asunder, the Horizontall Course is not the meane to finde those places, vnlesse they lie North and South: for the Horizontall course betwene any two places, is a portion of a great circle, which being of large distance, must be perfozmed by great circle Nauigation, and not by Horizontall Courses: for the collection of many Horizontall Courses being knit together, doe perfozme a paradoxall motion, altogether differing from a great circle: as for an example: being at Cape verde, there is a place distant from me 80. degrees, vpon the poynt North-west, vnto which place I desire to sayle, I therefore bring Cape verde vnder the Meridian of my Globe, there considering the latitude of the Cape, I raise the Pole answerable to the same, and place the Zenith directly ouer the Cape, then turning the Quarta altitudo to  
pract,



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the point Northwest vpon the Horizon all such places as the said Quarta altitudo then toucheth, doe beare due Northwest from me: now prosecuting this Course by the direction of my Compassse, the first day I sayle 20. leagues, therefore I make a marke by the edge of the Quarta altitudo, 20. leagues from the Zenith; then bringing that mark vnder the Meridian, I rectifie the globe answerable to the latitude thereof, the next day I sayle other 20. leagues vpon the same point, and make a marke as at the first, I bring that marke likewise vnder the Meridian, and rectifie the Globe as before, and by this methode prosecuting the Course *P. VII.* I shall describe a paradoxall line, which will lead mee to the North of the place vnto which I would sayle, the farther the distance, the greater the difference: by this order you may describe paradoxall lynes, vpon all the points of the Compassse, but this is to be regarded, that your differences be as small as you may, and that none of them excede 20. leagues, for by the smallest distinctions, is performed the greatest certaintie. And by the description of these lynes, you may very manifestly vnderstand the difference of Horizontall paradoxall and great circle Panigation.

And this may suffice for the sayling vse of the Globe, conuenient for the Seamans purpose.

### What is the great Circle Navigation?

**G**reat Circle Panigation is the chiefeft of all the 3. kindes of sayling, in whom all the other are contained, & by them this kinde of sayling is performed, continuing a Course by the shortest distance betwene places, not limited to any one Course, eyther horizontall or paradoxall, but by it those Courses are ordered to the full perfection of this rare practise, whose benefits in long voyages are to great purpose, ordering and disposing all horizontall traueses to a perfect conclusion: for there are many changes of horizontall and paradoxall Courses in the execution of this practise, so that vpon the shifting of a winde, when that it may seeme that you are forced to an inconuenient Course by the skill of great Circle sayling, that Course shall be found the shortest and onely proper motion to performe your voyage, And also

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When with fauourable winds the Pilote shall shape a Cozse by his Chart or Compasse paradoxall, as the best meane to attaine his Port, he shall by this kinde of sayling find a better and shorter Cozse, and by sufficient demonstration proue the same, so that without this knowledge I see not how Cozses may be ordered to their best aduantage: therefore sith by it the perfection of sayling is largely vnderstood, and the error likewise most substantially controled, it may of right challenge the chiefest place among the practises Vbernautick. The particularities whereof if I should by an orderly methode labour to expresse, it would be a discourse ouer-large for this place, and as I thinke troublesome if the premises be not well vnderstood: therefore I will now ouer-passe it, vntill a time more conuenient and of better leasure.

### Of paradoxall Nauigation.

**P**aradoxall nauigation, demonstrateth the true motion of the Ship vpon any Cozse assigned, in his true nature by longitude, latitude, and distance, giuing the full limit or determination of the same, by which motion lines are described neither circular nor straight, but concurred or winding lines, and are therefore called paradoxall, because it is beyond opinion that such lines should be described by plaine horizontall motion: for the full perfection of which practise I purpose (if God permit) to publish a paradoxall Chart, with all conuenient speede, and so will discover by the same at large, all the practises of paradoxall and great circle nauigation, for vpon the paradoxall Chart, it will best serue the Seamans purpose, being an instrument portable, of easie stowage and small practise, performing the practises of Nauigation as largely and as beneficially as the Globe in all respects: and all these practises of sayling before mentioned, may in a generall name be aptly called Panigation Geometricall, because it wholly consisteth of Geometricall demonstratiue conclusions.

But there is another knowledge of Panigation, which so far excelleth all that is before spoken, or that hath hitherto bin vulgarly practised, as the substance his shadow, or as the light surmounteth the thicke obscured darknesse: and this sweete skill of



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sayling may well be called Navigation Arithmetically, because it wholly consisteth of Calculations, comprehended within the limit of numbers, distinguishing Courses not only upon the points of the Compass, but upon every degree of the Horizon, and giueth the distance of any Trauers for the particular eleuation of minuts, yea, & lesse parts assure your selfe: it giueth longitudes and latitudes to the minute second and third: in so great certaintie, as that by no other meanes the like can be performed: it teacheth the nature of Angles and Triangles, as well Sphericall as plaine superficiall and solide Commensurations, the effect of lynes straight, circular, and paradoxall, the quantities and proportions of parallels, the nature of Horizons, with every particular distinction of any alteration whatsoever, that may in Navigation be required to a most wonderfull precise certaintie: for there can nothing be required, that by this heavenly harmony of numbers shall not be most copiously manifested to the Seamans admiration & great content: the orderly practise whereof to the best of my poore capacitie I purpose to make knowne, if I may perceiue my paines already taken, to be receiued in good part, which I distrust not but all honest minded Seamen, and Plyots of reputation will gratefully embrace, onely in regard of my friendly good will towards them, for it is not in respect of my paines, but of my loue, that I would receiue fauourable curtesies.

How may the Poles height be knowne by the Globe?

**T**here are diuers wayes to finde the Poles height by the Globe, as well from the Meridian as upon the same, but sith before I haue sufficiently taught how by the Sunnes Meridian altitude, the Poles height may be found, I will therefore in this place speake no further thereof, but for the other kinds it may be knowne as followeth.

How by the Sunnes rising or setting, the Poles height may be knowne.

**B**y your Compass of variation, or some magneticall instrument, obserue at the Sunne rising, upon what degree of the Horizon the center toucheth, according to the true horizontall position

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position of the Magnet, all variation duely considered, that being knowne, search in the Tables of the Ephemerides, for the Sunns place in the Ecliptick, at the time of your obseruation, then bring that place or degree of the Ecliptick wherein you find the Sunne to be to the Horizon, and moue the Meridian of the Globe as occasion requireth, vntill that obserued degree of the Horizon & the Sunnes place in the Eclipticke doe iustly touch together, for then is the Pole in his due Elevation, as by the intersection of the Horizon and Meridian may appeare, in like sort you may find the Poles altitude, by any knowne fixed Starre in the Horizon.

To finde the Poles height by the Sunne, vpon any point of the Compasse.

**B**y the Compasse of variation, rectified to the true Horizon-  
all position, obserue the Sunne vntill he come to any point thereof at your pleasure, and in the same instant take the Sunns height from the Horizon, then bring the Quarta altitudo to that point of the Compasse vpon the Horizon of the Globe where you obserue the Sunne to be, there holding the Quarta altitudo steadie, moue the Globe vntill you bring the degree of the Eclipticke (wherein the Sunne is at the time of your obseruation) vnto the edge of the Quarta altitudo, if it fall vpon that degree of altitude as was the Sunnes obserued height, then doth the Pole stand to his true Elevation, but if it agrée not, you must eleuate or depresse the Pole as occasion requireth, rectifying the Zenith answerable thereunto. And againe make tryall as at the first, bringing the place of the Sunne to the Quarta altitudo, and setting the same vpon the obserued point of the Compasse, vntill it agrée in all respects with your obseruation, and then the Meridian sheweth in his intersection with the Horizon, the elevation of the Pole from the Horizon.

To finde the Poles height by any giuen Azimuth by the Sunne being aboue the Horizon.

**B**y your Magneticall instrument, or Compasse of variation, obserue the Azimuth of the Sunne at any time in the fore-  
noon



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noone, or afternoone, the nearer the Sunne is to the Horizon, the better shall be your obseruation, and at the same instant take the height of the Sunne from the Horizon, keepe these two numbers in memory, and note that the Azimuth be obserued according to the true position of the Horizon, by hauing good regard to the variation of the Compasse, then bring the Quarta altitudo to the place of the Sunne in the Ecliptick, and set that degree of the Sunnes place in the Eclipticke vpon the obserued degree of altitude by the graduation of the Quarta altitudo, and if the end thereof at the same instant do fall right vpon the obserued degree of Azimuth, then is the Pole in his due Elevation: if not, then rayse or lay the Pole as occasion requireth, alwayes regarding that you place the Zenith answerable to the Poles altitude, and then againe bring the Sunnes place to his altitude vpon the Quarta altitudo, and looke againe whether the end thereof doe touch the obserued degree of Azimuth vpon the Horizon, if not, you must prosecute this order, vntill at one instant the place of the Sunne be vpon his true almicanter, by the edge of the Quarta altitudo, and that the end of the Quarta altitudo doe also touch the obserued degree of Azimuth vpon the Horizon, for then is the Pole in his true elevation, as by the Meridian and the Horizon will appeare.

To finde the Poles height by the Sunne by any two giuen Azimuths and altitudes, not regarding the true hor-  
izontall position or needles variations.

**B**Ecause there may great errors be committed in the former obseruations, vnlesse the Compasse be perfectly well rectified, so as it may respect the true parts or distinctions of the Horizon, it is not amisse to enforme you how without regard of variation, the Poles height may be found.

Therefore by your Magneticall instrument or Compasse of variation, obserue the Sunnes Azimuth, without regard of the true Horizontall position, and at the same instant obserue also his altitude from the Horizon, keepe those two numbers in memory, then after the Sunne hath moued a point or two points of the Compasse more or lesse at your discretion, obserue againe

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his Azimuth and altitude as at the first, then consider the arke of the Horizon, through which the Sunne hath moved betwene these two observations, so by the two observations of the Sunns altitude, and by the degrees of Azimuth through which the Sun hath moved, the Poles height is thus knowne: First, set the Globe to the elevation of the place wherein you are as nere as you can gette, and bring the Zenith to the like latitude from the Equator, as the poles elevation is from the Horizon, then bring the Quarta altitudo to the place of the Sunne upon the Eclipticke, so for the time of your observation, there place the Sun upon the first observed altitude by the degrees of the Quarta altitudo, and note the degree of the Horizon which the Quarta altitudo then toucheth: this done, bring the Sunnes place to the second observed altitude, by moving the Quarta altitudo and the Globe untill the degree of the Sunnes place in the Eclipticke, and the degree of his altitude upon the Quarta altitudo doe meete. Then againe consider the degrees of the Horizon, which the end of the Quarta altitudo toucheth, and note the arke of the Horizon contained betwene your two observations, of how many degrees it consisteth, if it agree with the observations made by your Magneticall instrument, then doth the pole stand in his true altitude, if not, you must either raise or depresse the Pole, and againe prosecute the former practise, untill you find such Azimuths and altitudes upon the Globe, as you found by your Magneticall observations, so then the Pole doth stand in his true altitude, and then doth also appeare the true Azimuth of both your observations, which if it agree not with your Compasse, then is your Compasse varied, and may hereby be corrected, so that this doth not onely giue the poles height, but also the true horizontall position without error.

To finde the Poles height by taking the Sunnes altitude above the Horizon, so that the precise time of any such observation be knowne.

If you desire at any time of the day to know the Poles height, as at 8. 9. or 10. of the clocke, &c. marke diligently the time of your observation, at what instant you doe observe the Sunnes altitude



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altitude from the Horizon, the time and altitude thus knowne, bring the place of the Eclipticke wherein the Sunne is at the time of your obseruation directly vnder the Meridian, there holding the Globe steadie, bring the Index of the Circulus horarius to the houres of 12. or noone, then move the Globe vntill the Index come to the houre of your obseruation, there hold the Globe steadie, then bring the Quarta altitudo to the place of the Sunne in the Eclipticke, if it agree with your obserued altitude, then both the pole stand in his true eleuation, if not, moue the Meridian by raising or depzeasing the pole as occasion requireth, vntill you bring the altitude and the houre to agree, and then you haue the poles height, and by the end of the Quarta altitudo doth also appeare the degree of Azimuth, whereupon the Sunne was at the time of your obseruation, and note that in raising or depzeasing the pole of the Globe, you must also place the Zenith so far from the Equinoctiall, as the Pole is from the Horizon, for this is a generall rule, that so much as the Pole is elevated from the Horizon, so much is the latitude of the Zenith from the Equator, therefore you must alwayes bring the Zenith and altitude to agree, whensoever you alter the eleuation, be it neuer so little.

To find the Poles height by any two obseruations of the Sunnes altitude, not regarding the houre of the day, or any horizontal position of the Magnet, so that you know the distance of time between the said obseruations.

**A**lthough there be some difficultie in giuing the true time of any obseruations at the Sea, by reason of the alterations of Horizons, and of the needlesse variation, yet it is a matter most easie by a good houre glasse, halfe houre glasse, and minute glasse, to measure the distance of time between any two obserued altitudes, you may therefore vpon that ground find the poles height with great facilitie at any time, by the Sunne or any fixed Star, in this sort.

Consider in what place of the Eclipticke the Sunne is at any time of your obseruation, bring that place to the Meridian, there with a blacke lead by moving the Globe describe a parallell to the Equator, answerable to the Sunnes diurnall motion and decli,

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clination for the same instant, then if betweene your obseruations there be an houre, two houres more or lesse at your pleasure, as by your running glasses may be knowne, you must allow for every houre 15. deg. of the Equator, for so much ascendeth every houre, and for every foure minutes one degree, and for every minute  $\frac{1}{4}$  of a degree, then knowing by this order how many degrees the Sunne is moved betweene your two obseruations, you must vpon the parallell which you draw make two notes, so many degrees a sunder as the Sunne hath moved between your obseruations, which may be done in this sort: bzing the place wherein the Sunne is vnder the Meridian, and marke what degree of the Equator is then vnder the Meridian, the Globe so standing vpon your parallell close by the Meridian, make the first note or marke, then turne the Globe, and reckon the degrees of the Equator that passe vnder the Meridian, vntill so many be past as was your obseruation, there againe holde the Globe steadie, and vpon your parallell close by the Meridian, make your second note or marke, then knowing the Sunnes altitude at both the obseruations, you must bzing the Quarta altitudo to the first note made vpon your parallell, there holding the Globe steadie, the Quarta altitudo, and marke agreeing in altitude, bzing the Quarta altitudo to the second note, if that doe also agree with your former obserued altitude, then both the Globe stand in his true Elevation, if not, you must eleuate or depresse the Pole by discretion, vntill you bzing the two obserued altitudes of the Sunne to agree with the two marks which you made vpon your described parallell, and then is the Pole at his true elevation: and what is spoken of the Sunne, the like may be done by any knowne fixed Starre. I hold this conclusion to be very necessary, pleasant, and easie for the Seamans purpose.

To finde the true place of the Sunne in the Ecliptick  
at all times,

**B**Ecause it is most necessarily required in the former practises, that the Sunnes true place in the Ecliptick be at all times knowne, I thinke it not amisse to enforme you how the same may be done.



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The chiefest and most certaine meane to know the same, is by the tables of the Ephemerides, but those tables wanting, the Seaman may in this sort doe it: by the Regiment seeke out the Declination of the Sunne, that being knowne, bring the Zenith vpon the Meridian, so many degrees & minutes from the Equator as is the Sunnes declination, then moue the Globe vntill some degree of the Eclipticke doe come directly vnder the poynt of the Zenith, for that is the Sunnes place: you must further consider, whether it be betwene March and June, for then you must finde the degree in that quarter of the Ecliptick, contained betwene  $\gamma$ , and  $\mathcal{S}$ : if it be betwene June and September, you must finde the degree in that quarter of the Ecliptick, contained betwene  $\mathcal{S}$ , and  $\omega$ , &c. of the rest.

It may also be knowne vpon the Horizon of the Globe by a Calender Circle that is there described, in this sort: first search the day of your moneth wherein you desire to know the Sunnes declination, and directly against the same degree which standeth for that day, doth also stand the degree of the Zodiac wherein the Sunne is at the same time, in a circle representing the Zodiac, and described vpon the Horizon.

But if it be Leape yeare, you must not take the precise day of the moneth wherein you see the Sunnes place, but the next day following, and against that day seeke the declination.

To finde the Poles height by any two knowne fixed Starres.

**W**hen you see any two fixed Starres which you know to be both at one instant in the horizon vpon your Globe search for those Starres, and bring one of them to touch the Horizon of the Globe, if the other doe not likewise touch the Horizon, you must raise or depresse the Pole by discrete moving of the Meridian, vntill you bring both those Starres to be at one instant in the Horizon, for then the Globe doth stand to his true elevation.

To finde the Poles height by any two knowne fixed Starres another way.

**W**hen you see any fixed Starre that you know to be in the Horizon, you must presently take the height of some other

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other Starre, that you likewise know, before the first be risen from the Horizon, then vpon your Globe search for the Starre that you obserued in the Horizon, bring that Starre to the Horizon of the Globe, there holding the Globe steadie, bring the Quarta altitudo to the other Starre whose altitude you obserued, if it agree vpon the Quarta altitudo with the obserued altitude, then the Globe doth stand to his true eleuation, if not, you must by discretion raise or lay the Pole, vntill you find the one Starre in the Horizon, and the other vpon his true obserued altitude, for then the Pole doth stand to his true eleuation.

To finde the Poles height at any time by any two knowne fixed Starres.

**V**ith your crosse stasse take the distance of any two stars from your Zenith, which must be done with as much expedition as may be, their distances so knowne, with a paire of Compasses, measure so many degrees vpon the Equator, as is the distance of the first obserued Starre, with another paire of Compasses doe the like for the second obserued Starre, vpon the first star set one point of the Compasses that tooke his distance, and vpon the second star set likewise one foot of the Compasses that tooke his distance, bring the other two feet of the Compasses to meete together, there make a marke, for that is the parallell wherein you be, that marke is the Zenith, bring it to the Meridian by mouing the Globe, and there will appeare the latitude desired, for so many degrees and minutes as that marke is from the Equator, so much is the Pole eleuated above the Horizon. This conclusion the Seaman ought to haue in good esteeme.

To know the precise houre at all times by the Sunne.

**F**or the finding of the houre of the day by the Globe, it is necessary that the Poles height be first knowne, therefore set the Pole to his true eleuation, and the Zenith to his answerable latitude, then bring the place of the Sunne in the Ecliptick vnder the Meridian, there holding the Globe steadie, place the Index of the Circulus horarius vpon 12. of the clocke or none, your Globe thus



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thus ordered, then with your Crosse stasse take the Sunns height from the Horizon, that being knowne you must bring the place of the Sunne to the Quarta altitudo, by moving the Globe and Quarta altitudo untill the place of the Sunne doe agree with the observed altitude, there holding the Globe that he move not, the Index doth shew upon the Circulus horarius, the true houre desired.

To finde the houre of the night by any knowne fixed Starre.

**S**et the Globe to his true altitude, and the Zenith to his answerable latitude, you must also place the Index of the Circulus horarius upon the houre of 12. or none, by bringing the Sunnes place under the Meridian, &c. as before you did by the Sunne, then take the height of any knowne fixed Starre, bring that Starre to the Quarta altitudo, by moving the Globe and Quarta altitudo, untill the Starre come to his true observed altitude, there holding the Globe steadie, the Index doth shew upon the Circulus horarius, the true time of your observation.

To know the length of the dayes and nights, at all times, and in all places.

**T**he place and time being given wherein you desire to know the length of the day or night, first set the Globe to his altitude for the place, then search the place of the Sunne in the Ecliptick, for the time wherein you seeke the dayes length, bring that place of the Sunne under the Meridian, there holding the Globe that he move not, place the Index of the Circulus horarius upon the houre 12. or none, then turne the Globe untill you bring the place of the Sunne to touch the East part of the horizon, there holding the Globe, you shall see by the Index of the Circulus horarius, the true time of the Sunnes rising, then bring the place of the Sunne to the West part of the Horizon, & you shall there see the true time of the Sunnes setting, whereby the length of the day and night doth most plainly appeare. And this may suffice for the vse of the Globe, necessary for the Seamans vse.

I might here recite the triple rising and setting of the Starres, Colnice, Acronice, and Heliace, the ascensions right & oblique, the dayning and stay light, houres equall and unequall, ordinary and planetary, dayes naturall and artificiall, the triple rising

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of the Sunne, Equinoctiall and Solsticiall, Circles of position, with their vse and nature, the horoscope and demising distinctions of the heavens, the planets, their motions, retrogradations, and exconcrictie of their orbs, horologie, and many other most pleasant conclusions: but because they doe in no sort appertaine to the Seamans vse, I therefore omit them, as matters more troublesome then profitable for him, expecting from some learned Mathematician a worke of worthy esteeme, wherein these and many other excellent conclusions shall by cunning demonstration be made knowne vnto vs.

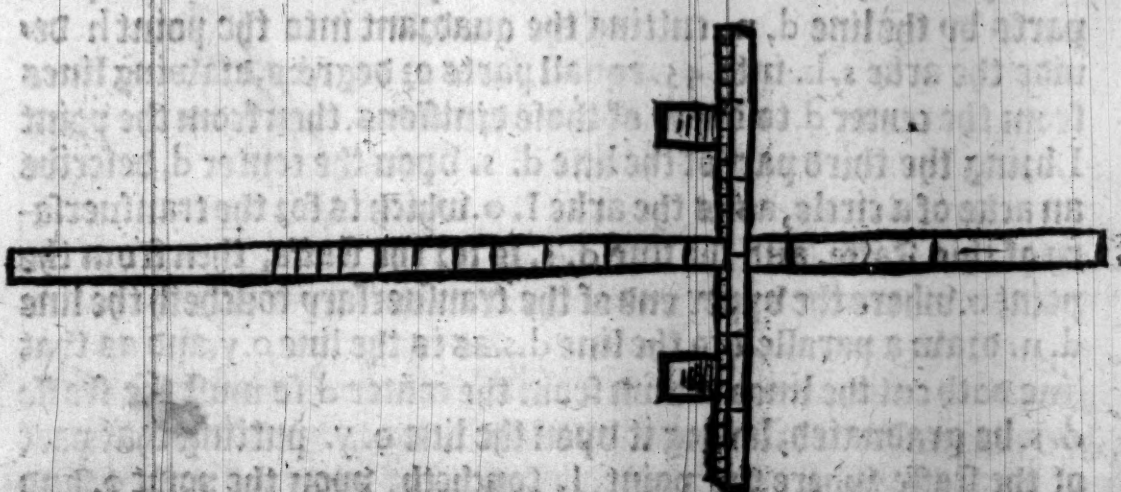
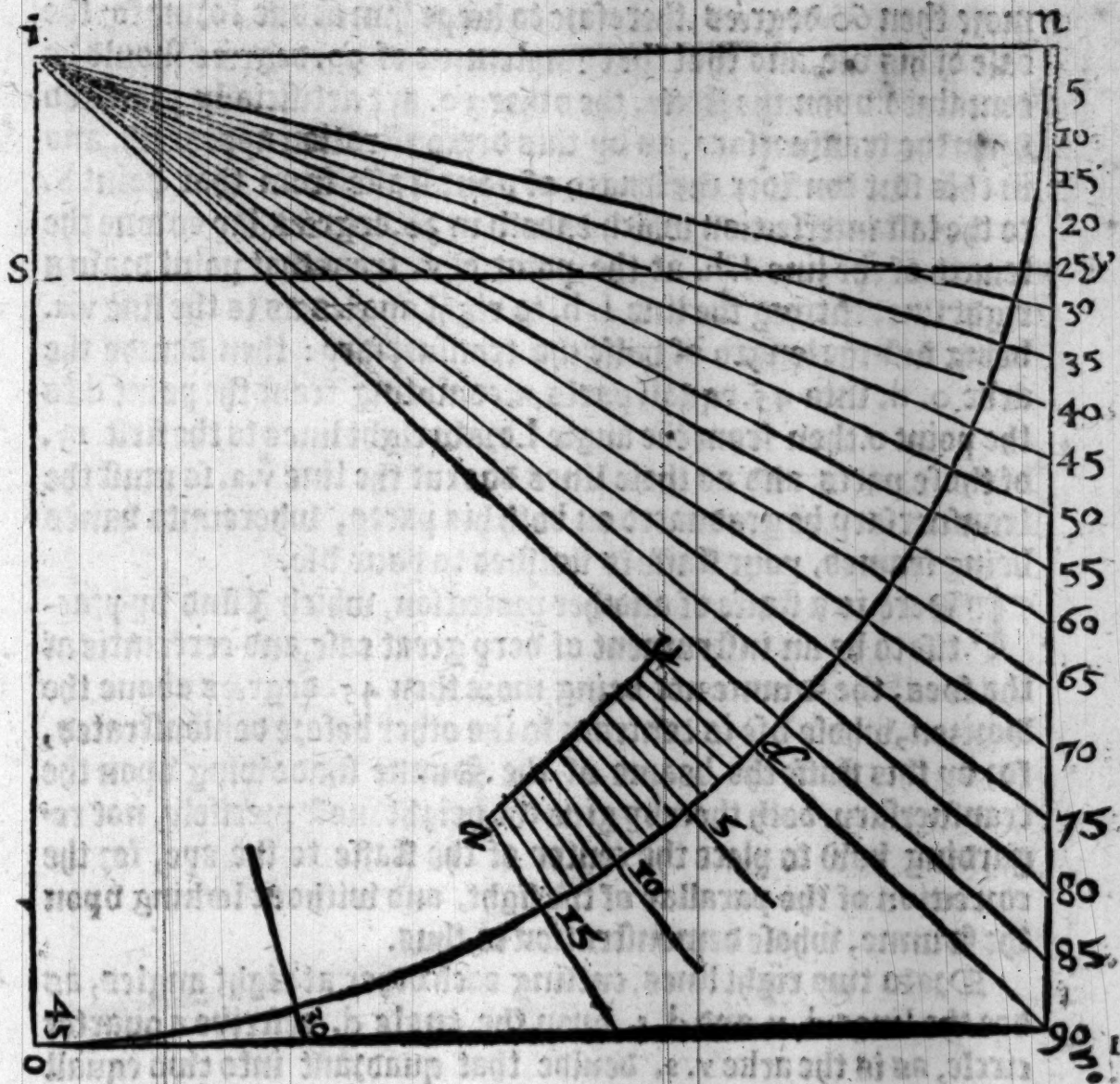
Of the Crosse staffe and his demonstration.

**T**he Crosse staffe is an artificiall quadrant, geometrically projected into that forme as an instrument of greatest ease and exactest vse in Nauigation, by which in any naturall disturbance of weather (the Sunne or Starres appearing) the Poles height may be knowne, when the Alrolabie or quadrant are not to be vled. Conueying the vse of the quadrant from the beame of the Sunne to the beames of the eye, for whereas by the quadrant the Sunne beame perceiuing the Dioptra sheweth his height, so by the Crosse staffe the beame of the eye conueyed to the Sun or Starre, doth likewise giue their height. The demonstration whereof is thus.

Make a plaine square consisting of foure right angles, as is the square, I. o. h. n. the angle I. shall be assigned the Center of the quadrant, where placing one foote of your Compasses, stretch the other foote to the angle n. and therewith describe a quarter of a circle, as is the arke o. d. n. then from the center I. to his opposite angle h. draw a right line, by which line the quadrant o. d. n. is deuided into two equall parts, in the point d. deuide the arke d. n. into 90. equall parts, drawing from the center I. lines through euery of those diuisions touching in the line n. h. as by this figure appeareth: then consider the length of your transferrary, & take halfe thereof, laying it vpon the line I. o. in the point S. from that point S. draw a parallell to the line I. n. as is the line S. y. and as that line doth intersect the diuision of the halfe quadrant, so shall be the degrees of the Crosse staffe, and note that the sides of the square, must be as long as the staffe that is graduated.



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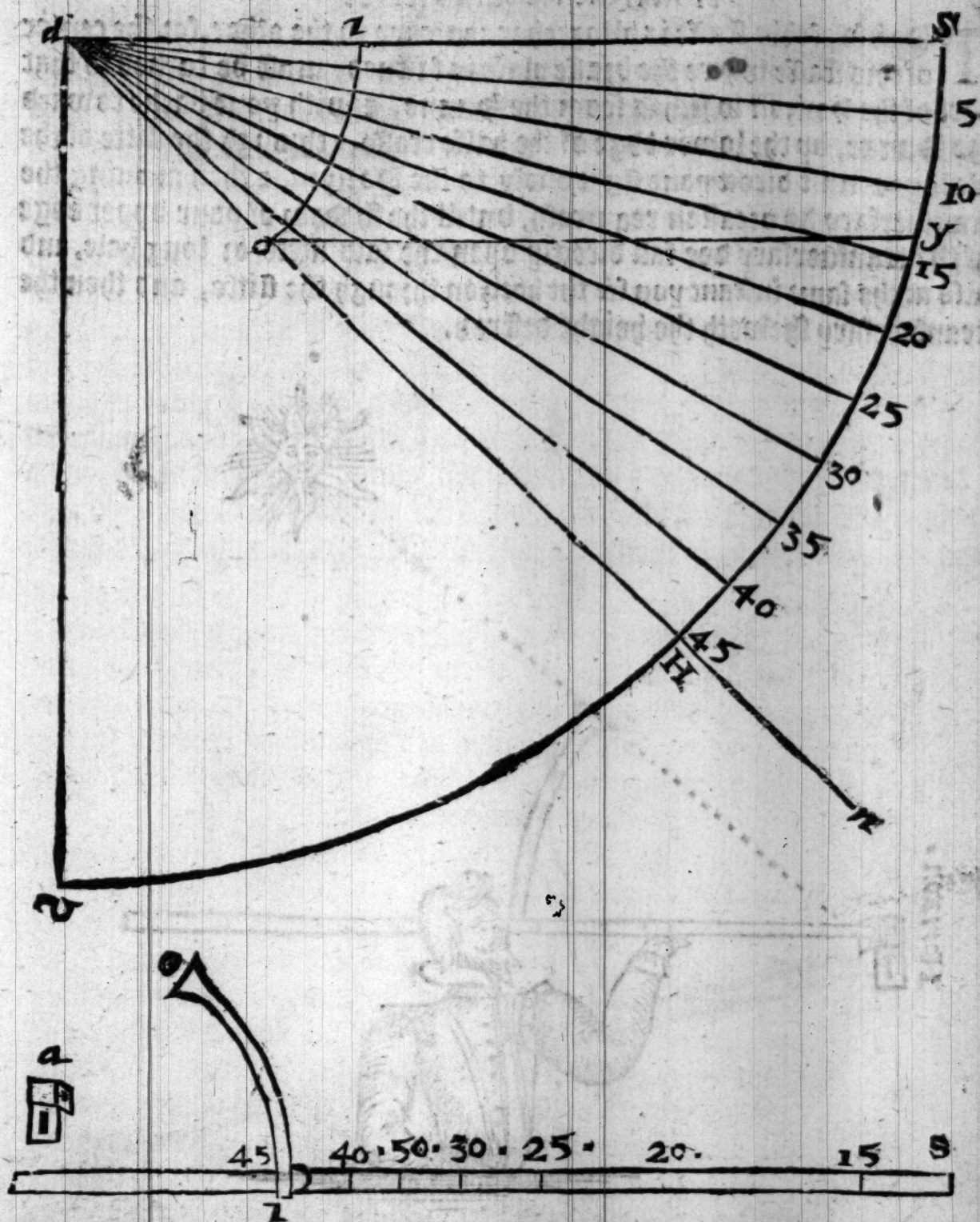
more then 60. degrees, therefore to keepe him in due forme for the ease of his vse, and that the complement of 90. degrees should be contained vpon the stasse, the other 30. are artificially projected vpon the transuersary, as by this demonstration appeareth, and in this sort consider the length of your stasse from that point S. to the last intersection which endeth in 30. degrees, lay downe the length of the line I. h. at the point of v. from that point draw a right line, cutting the line I. h. to right angles, as is the line v. a. being iust the length of halfe the transuersary: then deuide the arke o. d. into 45. equall parts, accompting from the point d. to the point o. then from the angle I. draw right lines to the first 15. of those parts, and as those lines doe cut the line v. a. so must the transuersary be graduated on both his parts, whereunto vanes being framed, your stasse is finished to your vse.

**T**here is a stasse of another projection, which I find by practise to be an instrument of very great ease, and certaintie at the Sea, the Sunne not being more then 45. degrees aboue the Horizon, whose vse is contrary to the other before demonstrated, for by this stasse the beame of the Sunne shadowing vpon the transuersary, doth thereby giue the height most precisely, not regarding how to place the center of the stasse to the eye, for the correction of the parallax of the sight, and without looking vpon the Sunne, whose demonstration is thus.

Draw two right lines, cutting each other at right angles, as doe the lines d. v. and d. s. vpon the angle d. describe a quarter circle, as is the arke v. s. deuide that quadrant into two equall parts by the line d. n. cutting the quadrant into the point h. deuide the arke s. h. into 45. equall parts or degrees, drawing lines from the center d. to euery of those diuisions, then from the point I. bring the third part of the line d. s. vpon the center d. describe an arke of a circle, as is the arke I. o. which is for the transuersary of this stasse, and the line d. s. is for the stasse, then from the point o. where the vpper end of the transuersary toucheth the line d. n. draw a parallell to the line d. s. as is the line o. y. and as that line doth cut the lines drawn from the center d. so must the stasse d. s. be graduated, laying it vpon the line o. y. putting that part of the stasse where the point I. toucheth, vpon the point o. and then from the point I. lay downe the degrees, as are the intersections vpon the line o. v. and so is the stasse graduated.



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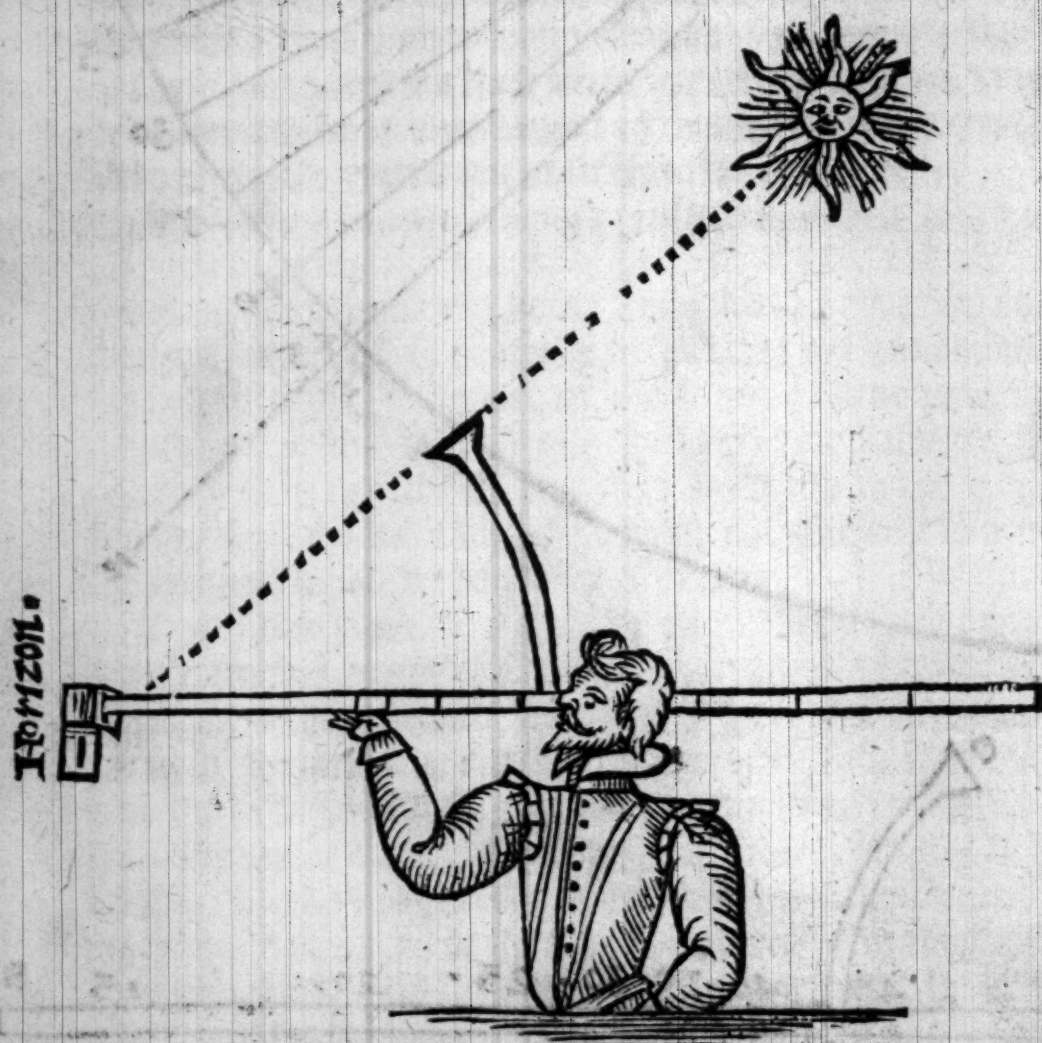


**T**he transfuersary at the point i must haue an artificial hole made for the staffe to run in, as other staues haue, also there must be a plate of brasse with a soccat to be set to the center of the staffe, as is the figure a in the midst whereof there must be a slitte, through which the sight must be directed to the horizon. & this plate must receive the shadowe of the

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How is the vse of this staffe?

**T**he vse of this staffe is altogether contrary to the other, for the center of this staffe where the brasse plate is fastned, must be turned to that part of the Horizon which is from the Sunne, & with your backe toward the Sunne, by the lower edge of the halfe crosse, & through the slitte of the plate you must direct your sight onely to the Horizon, & then moving the transuersary as occasion requireth, untill the shadow of your upper edge of the transuersary doe fall directly vpon the said slitte or long hole, and also at the same instant you see the horizon through the slitte, and then the transuersary sheweth the height desired.



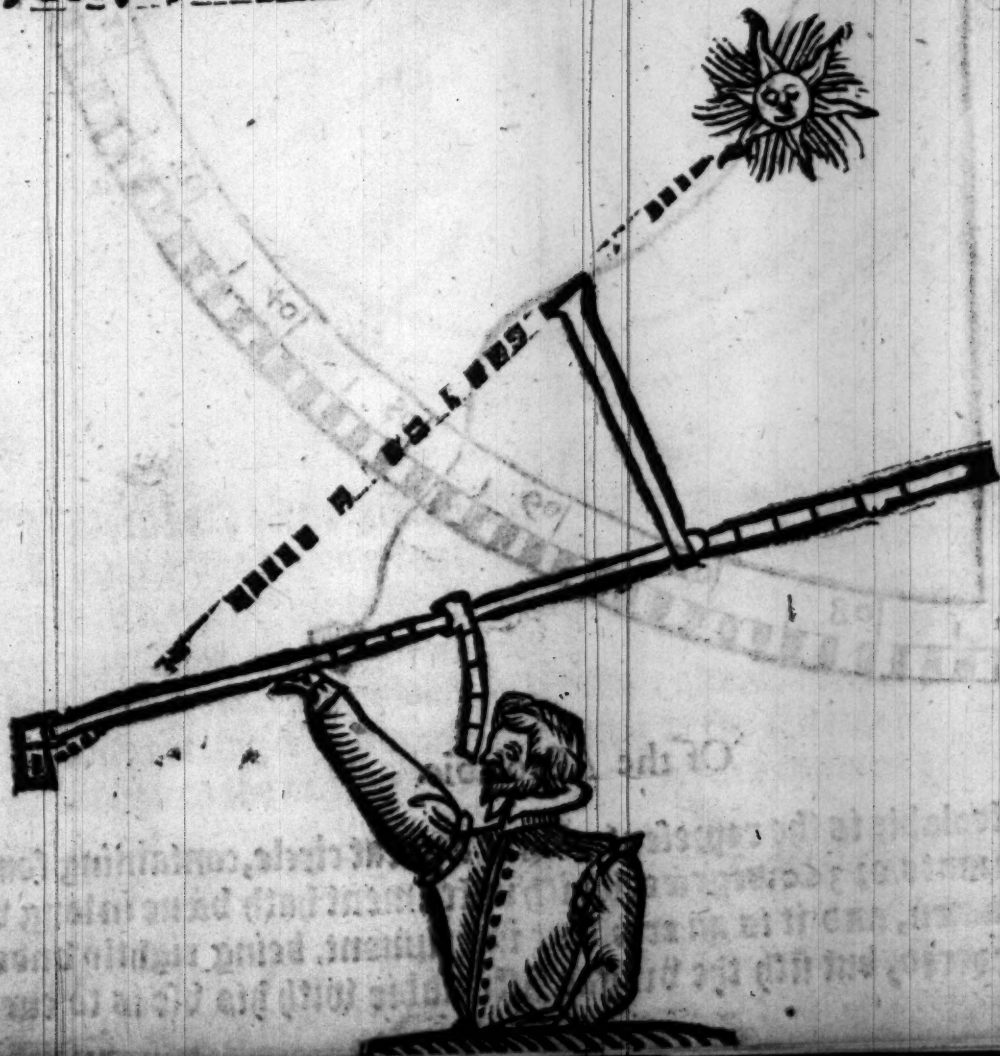
**F**inding by practise the excellency of the Crosse staffe above all other instruments, to satisfie the Seamans expectation and also knowing that those instruments whose degrees are of largest capacitie, are instruments of most certainty. I haue very carefully laboured to search a good and demonstrable means how a Crosse staffe might be projected not only to con-



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taine large degrees, but also to auoyd the vncertainie of y<sup>e</sup> sight, by disorderly placing of the staffe to the eye, which demonstration I haue found, & haue had the instrument in practise, as well vnder the Sun, as in other climates, but because it hath a large demonstratio<sup>n</sup>, with manifold v<sup>s</sup>es, I here omit to manifest the same, purposing to write a particular treatise thereof, notwithstanding his forme & v<sup>s</sup>e, by picture I haue thought good to expresse.

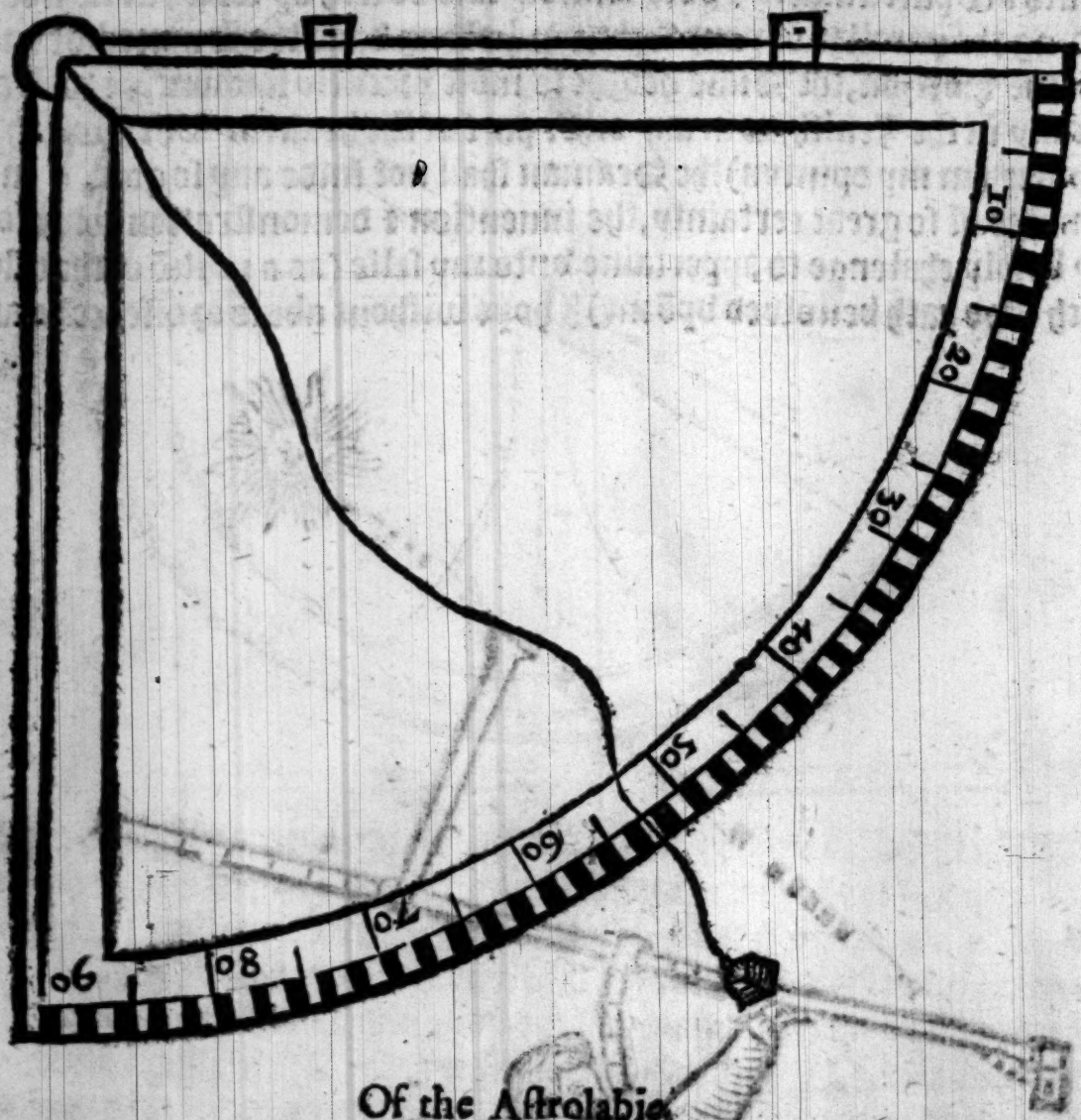
**T**his staffe is a yard long, hauing 1. halfe crosses, the one circular, the other straight, the longest not 14. inches, yet this staffe doth contain the whole 90. degrees, the shortest degree being an inch &  $\frac{1}{4}$  long, wherein the minutes are particularly & very sensibly laid down, by which staffe not regarding the parallax of your sight, nor looking vpon the Sunne, but onely vpon the Horizon, the Sunns height is most precisely knowne, as well and as easily in the Zenith, as in any other part of the heauen. Then which instrument (in my opinion) the Seaman shall not finde any so good, & in all Climates of so great certainty, the inuention & demonstration whereof I may boldly chalenge to appertaine vnto my selfe (as a portiō of the talent which God hath bestowed vpon me) I hope without abuse or offence to any.



## The Seamans Secrets.

### Of the Quadrant.

**A** Quadrant is the fourth part of a circle, containing 90. degrees, and representeth the distance betwene the Horizon and Zenith, being an excellent instrument vpon the shore, to performe any Astronomicall observations, but for a Seaman it is to no purpose: and although there may be very much written of the commodious and excellent vles of the Quadrant, yet not being an apt instrument for Sea observations, it shall be from my purpose to write further thereof, and therefore the onely laying downe of his forme may at this present suffice:



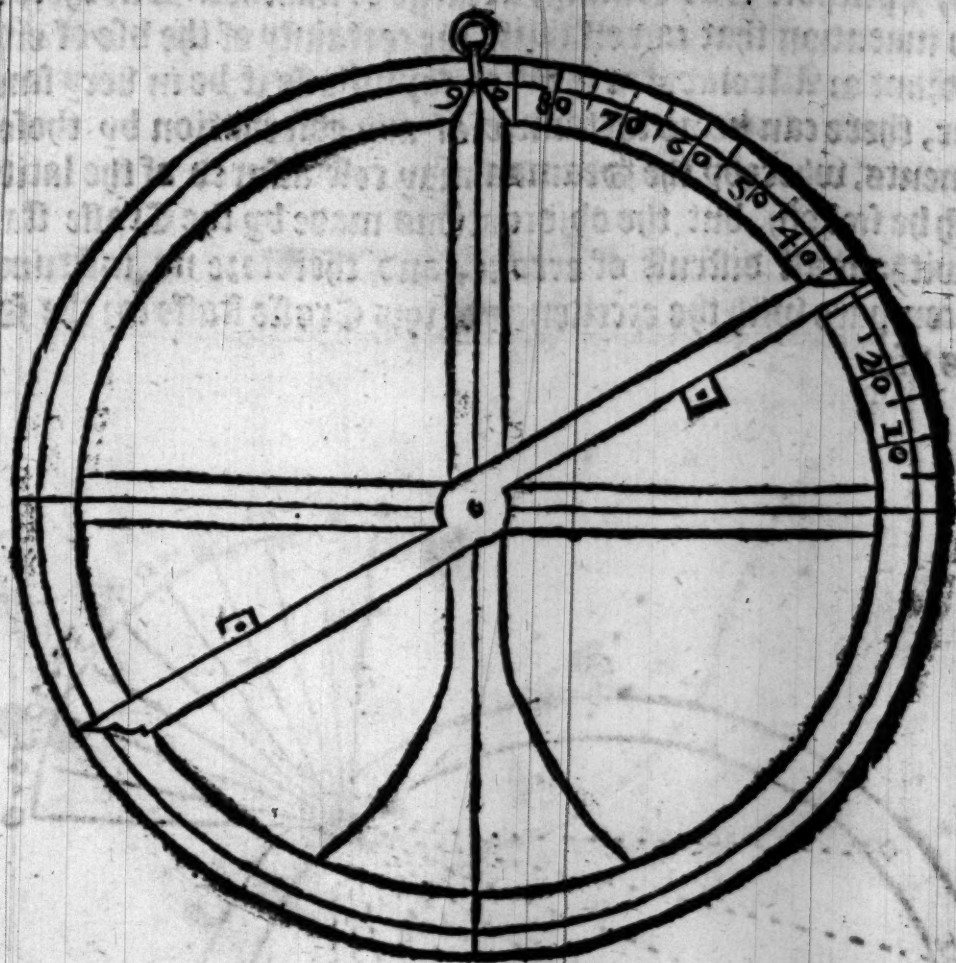
### Of the Astrolabie.

**A** Astrolabie is the representation of a great circle, containing four Quadrants, or 360. degrees, which instrument hath bene in long vse among Seamen, and it is an excellent instrument, being rightly vnderstood and ordered, but sith the vulgar Astrolabie with his vse is to euery Seaman.



## The Seamans Secrets.

Seaman sufficiently knowne, it should be vaine labour for me to lay downe his use and demonstration: therefore by his forme it shall suffice to expresse him.



**T**here hath bene great paines taken by many for the enlarging of the degrees contained in an Astrolabe, among which there is a projection to conuey the degrees of a Quadrant into the concavities of an Astrolabe, whereby these degrees shall be double, to any other Astrolabe, of the same quantitie, so that the Sun beame pearcing a hole made in the side of the Astrolabe, is thereby carried to the degrees noted, in the opposite concave part, as by his forme may appeare.

Also my selfe labouring in the same matter, haue found a meane whereby an Arke of a Quadrant whose side is 10. fote, may be conueyed into an Astrolabe of 10. inches diameter, whose Dioptra shall cut his lymbe to right angles, and shall performe the comple-

ment

## The Seamans Secrets.

ment of 90. degrees, as amply and as effectually as by the Quadrant it may in any sort be done.

Whose demonstration, together with the demonstration of my staffe, I purpose God willing, at large to manifest: But there can be no inuention that can establish the certainty of the vse of either Quadrant or Astrolabe at the Sea: for unless it be in very smooth water, there can be no certaintie of any obseruation by those instruments, whereby the Seaman may rest assured of the latitude which he seeketh, but the obseruations made by the Crosse staffe, are without all distrust of error, and therefore no instrument may compare with the excellencie of this Crosse staffe for the Seamans vse.

